

# BOSTON UNIVERSITY GRADUATE SCHOOL

THESIS

VEGETATIONAL CLIMAXES OF THE STATE OF NEW YORK

Ву

William James Verner Babcock

(A. B. Eastern Nazarene College, 1937)

Submitted in partial fulfillment of the requirements for the degree of

Master of Arts

1939

Digitized by the Internet Archive in 2016 with funding from Boston Library Consortium Member Libraries

https://archive.org/details/vegetationalclim00babc

1939 ba

#### APPROVED BY

Professor of Brology

Second Reader Breuton R. Luz

Professor of Biology

First Reader . Thrank . N . Thrand . . . . 

#### VEGETATIONAL CLIMAXES OF THE STATE OF NEW YORK

## Topical Outline

	Topic	Page
I.	Geological Background	1
	General Topography of New York State	8
II.	Xerophytic Succession in New York State	11
III.	Hydrophytic Succession in New York State	19
IV.	Mesophytic Extension in New York State	27
	Factors of Climax Growth	27
	The Floral Zones of New York as Meso-	36
	phytic Climax	
V.	Summary	56
	Bibliography	60

#### VEGETATIONAL CLIMANES OF THE STATE OF NEW YORK

## Topical Cutline

12		
·II	Kerophytic Succession in New York State	
.II		
.VI		
	Pactors of Climas Growth	
	The Florel Youes of New York as Meso-	
.V		

# VEGETATIONAL CLIMAXES OF THE STATE OF NEW YORK

### List of Illustrations

Figure No. Illustrating:	Page
1. photo Climax from Xerophytic Condit	ions 12
2. photo Climax on Sand	14
3. photo Climax on Sand	14
4. photo Lean Climax on Sand	15
5. diagram Soil condition on Sand Bed	17
6. diagram Succession from Open Water to	Meso-
phytic Forest	20
7. photo Hydrophytic Succession	23
8. photo Hydrophytic Succession Persi	
9. photo Bog Climax	25
10. photo Bog-like Succession	26
11. chart Frosts in New York	29
12. chart Mean Temperature per year in	
York	31
13. chart Mean Rainfall per year in New	
14. chart Floral Zones in New York	35
15. photo Thin Soil Cover	37
16. photo Mountain Side Soil Bed	37 51
17. photo Zone 2 Indicator 18. photo Zone 2	52
18. photo Zone 2 19. photo Zone 3	52
20. photo Arctic Vegetation	53
21. photo Whiteface Mountain Top	54
22. photo Boreal Forest	54
23. photo Reforestation	58
proto protocolor	

#### VEGETATIONAL CLIMAXES OF THE STATE OF NEW YORK

#### anolderstaulil to dell

		.01	
			tong .1 tong .8 tong .8 tong .4
	Succession from Open Nater to Meso-		diag.
	Hydrophytic Succession -Persistence Son Cilman		7. photes.
	Bog-like Succession Frosts in New York Mean Temperature per year in New		10. photos
	York Mean Rainfall per year to New York		13. chair
25 27 28 28 28 28 28	This Boil Cover Mountain Side Soil Bed Sone S Indicator Zone S		15. phot 16. phot 17. phot
58 58 58 58	Zone 5 Arctic Vegetation Whiteface Mountain Top		19. photo
\$6. 58.			22. phot 25. phot 24. phot

#### INTRODUCTION

The natural vegetation of any sizable area usually presents enough contrasting features to arouse mental, if not verbal, questions as to why or how variations would appear so frequently. The State of New York has many features that permit a variation of the vegetational climax. The purpose of the following treatment of the subject VEGETATIONAL CLIMAXES OF THE STATE OF NEW YORK is to make an acquaintance with the factors that influence, or, more truly, help to cause the varied vegetation within the State of New York. In pursuit of this goal the writer considers the totality of the floral members of any area as one unit, namely, "the vegetation of that area". In the light of this, climax forms whether in associations, societies, or pure stands are given much more significance than a digest or analysis of the individuality of floral members in an area. The term "factors" is inclusive. geological, geographical, climatci, and biological phases being thus grouped together.

#### THE DUCCIT ON

varied vegetation within the State of New York. In nursuit flored morbers in an area. The term "factors" is inclusive.

VEGETATIONAL CLIMAXES OF THE STATE OF NEW YORK

#### I. Geological Background

"America is called the 'New World', but, as we now know, that portion of North America which lies immediately north of the St. Lawrence and the Great Lakes, with its extension southward, the Adirondack region, is the oldest part of the earth's surface. This land area, sometimes wider, sometimes narrower, and gradually increasing, has continued to exist throughout all geological time; hence it is not surprising that we have here the most complete and connected history of plant life."

Part of this land sank in Lower Silurian time, and the sea covered a large area; for example, the Potsdam sandstone is found to contain abundant marine fossil forms being

"in a thousand places covered thickly with a network of interlacing stems of seaweeds, or rather their casts, because the vegetable tissue has all disappeared."1

Not much is known previous to the Silurian Age except for quantities of carboniferous matter now graphite of plant origin, either of marine plants or of land plants.

While the land mass of the Upper Silurian Age was less extensive, there are in its deposits "indisputable evidence of the existence of land plants." This evidence is in the form of remains of ferns, lycopods, equisetae, and conifers, small in size and rather few in number, indicating that land vegetation must have been rather sparse.

"The subsidence giving rise to the series of sediments of the Devonian System was less extensive than those taking place before the area of permanent

# I. Geological Recurround

"America is called the 'New Morld, but, as we may know, that portion of Morth America which lies and the fine set is a set in the state of the state is a state of the set is a state of the set is the oldest part of the earth a surface. This land area, sometimes wider, semetimes narrower, and gradually increasing, has continued to exist throughout all goological time; hence it is not surprising that we have here the most complete and continued that or size of state is not size or state of the stary of plant life."

Part of this land sent in Lower Silurian bime, and the sen covered a large area; for example, the Potestam sendations in found to contain shundard marine forms least forms being

"in a thousand piaces envered thickly with a network of interlacing stems of seaweds, or rather their casts, because the verstable bissue has all disapported."

Not such is known previous to the bilurian age except for quantities of carboniferous matter now respect of plant or in the element of land plants.

Unite the land case of the Upper Silurian Ace was lass extensive, there are in its deposits "Indianybella evidence of it in its deposits "Indianybella evidence is in the cristence of land plants." I This evidence is in the form of remains of ferms, Apocpoin, equidable, and conifers, and conifers, excited in alse and rather few in number, indicating that land versialism must have been rether elerse.

to colons and of self gulvin consblucts on"

aviance of the Devonier Description of the area to the self of the se

land was greater, but the proof that this land was covered by a luxuriant, beautiful, and varied terrestrial flora is conclusive."

Dawson describes over one hundred species of fossil plants from the Devonian rocks of Canada and New York. The most interesting Devonian plants are found in the limestone of Ohio and the Hamilton rocks of Gilboa, N. Y. Apparently there was a time when the land submergence produced a series of islands from the Great Lakes to Tennessee. On the "shores" of these "islands" there are remains of similar plant life. Along one of these shores at Gilboa are found tree forms of several sorts, some of the trunks being two feet in diameter; Noggerathin, a supposed cycad; Lepidodendron, a lycopod; and (according to Dawson) Psilophyton, connecting the ferns and lycopods which were widely found in the Devonian Age.

The Carboniferous Age continued an expansion of the Devonian Age. Newberry thinks about one-half of the Carboniferous forms of plants should be considered identical with similar forms of this age in Europe. It is interesting to note that New York contains very little coal while nearby Pennsylvania has very extensive coal beds. One might then infer that the abundant vegetation usually thought to belong to the Carboniferous Age was not present in New York. This would not necessarily be true, for general mass movement of water could easily remove vegetation in one region and pile it up or deposit it in another region. The Triassic and Jurassic floras, Newberry considers essentially alike in

land was greater, out the proof that this land was covered by a luminant, beautiful, and varied terrestrial flore is conclusive."

Dawson describes over one hundred apenies of fossil plants from the Devenies rocks of Canada and New York. The most interesting Devenies plants are found in the limeatone of onic and the Hamilton rocks of Oilboe, N. Y. Apparently there was a time when the land submergence produced a suries of islands from the Great lakes to Temmessee. On the "shortes" of tacas "islands" there are remains of similar plant life. Alon; one of these ancres at Cilcas are found tree forms of according to these tranks being two feet in distator; and (seconding to Dawson) Pailophyton, connecting the force and lycopeds which were widely found in the Davanian Age.

The Carconiferous Ace continued an expansion of the

The Darconiferous Are continued an expension of the Devoulan Age. Newberry bind a about one-half of hee Car-boniferous forms of plants should be considered identical with similar forms of this are in Europe. It is interesting to note that New York occiains very little cost while near-by Pennsylvania has very extensive cost neds. One alight then infer that the abundant very extensive cost neds. One alight then to the Carboniferous are wan not present in New York. This would not necessarily be true, for general mass movement of water could easily rerove verstation in one region and pile it up or deposit it in snother region. The Triansic and Jureacia florms, Newberry considers easentially alige in

botanical character. There is a complete change from the paleozoic to the Mesozoic era. The lycopods have become insignificant, the sigillarids are extinct, and the calamites have given away to the true equisetae. The conifers and cycads have multiplied until they have become the most conspicuous forms of vegetation. The conifers were Araucarians; some with close, rhomboidal, appressed discs for leaves; others with divergent fleshy scales like the present Brazilian Araucaria; and still others with filiform leaves like the modern spruces. The cycads were almost infinitely varied, some aborescent with lofty trunks crowned with graceful canopies, other spheroidal masses marked with rhombic leaf scars. Remarkable changes occurred in the ferns also.

The changes of the Cretaceous Age were the most complete of any period, developments not understood occurring not by transition but by sudden eruption. The angiosperms seem to have spread over the face of the earth by the beginning of the Cretaceous period. Bray<sup>2</sup> cites them as being widely distributed by the end of the Cretaceous period. Newberry<sup>1</sup> thinks the Cretaceous sea invaded a forest of oaks, willows, sassafras, magnolia, tulip tree, sweet gum, in fact many forms of our present flora. At this point Bray and Newberry are in dispute. Bray agrees with Newberry in general as to existing forms, but he goes on to submit the idea that much of our present flora began in the Arctic. As a gradual cooling took place the floral society migrated southward, only

The changes of the Cretaceous Age sere the most complete of any period, developments not understood occurring not by transition but by sudden eruption. The englosperms seem to neve agreed over the face of the earth by the beninding of the freteneous period. Brage often them as ceing widely distributed of the end of the Gretaceous period. Homberryl thinks the preteneous see invaded a forest of cake, willows, seement, the present flore. At this point frey and Newberry are our present flore. At this point frey and Newberry are existing forms, out he goes on to appoint the idea that much of our present flore uses with Newberry in general as to existing forms, out he goes on to appoint the idea that much of our present flore uses in the Archic. As a stadue, col-

the hardier remaining until the advancing cold overtook them. As evidence he submits the picture represented by the order in which fossil forms of plant life are found in the Arctic and southward. Nearest the surface of present day Arctic flora are found sub-Arctic forms. Beneath these are more temperate forms and yet beneath the temperate forms are fossils of sub-tropical and tropical plants. Newberry suggests that since the forms of this period are so similar to present day forms a mild temperate climate must have prevailed over all North America, permitting a migration northward of the more southern flora. Some geologists advance the theory that at this period a land bridge from northern Canada and Greenland to Europe by way of Iceland and the New Hebrides made possible a two-way migration or exchange of floral forms, thus accounting for the great similarity of northern European forms and North American forms. At present an elevation of only two thousand feet across this region would produce such a land bridge, a small altitudinal difference in great crustal fluctuation. The same type of bridge to Siberia across the Bering Sea is thought to have been probable.

According to Newberry<sup>1</sup>, the floral climax of all time was reached in the Tertiary Period. He calls our present flora a mere wreck of what it was before the Ice Period, if we judge from the aborescent plants. He claims that more forms have already been found as fossil than exist now on the earth's

According to Newberry, the florel olies of all time
was reached in the Tertiary Period. He calls our present flore
a mere wroth of what it was before the lee Beriod, if we
judge from the aborescent plants. He cluims that move forms
have already been found as fossil then exist now on the earth's

surface. He reports fossil sycamore leaves two feet in diameter of a half dozen species now extinct, camphor trees, palms, and figs, which were general features of the Tertiary but are now found only in the tropics.

The close of the Tertiary era is recognized by most geologists as being a period of great terrain movement or change; mountains already formed were modified, more mountains reared up by great crustal fluctuation and more land appeared above the sea level. Changing conditions had already produced greater adaptability of plant life to existing conditions so that the Angiosperms, which had now become dominant almost everywhere, could better stand further changing of conditions.

The Angiosperms seem to have become dominant almost everywhere by the eve of the most recent of geological eras, the Glacial Period. This period is commonly understood to have been a time when temperature and moisture conditions permitted the formation of great ice sheets which moved down over New England, New York, and the upper parts of the Appalachian range. Very obviously, this would have a profound effect upon vegetation. Indeed, if the species were not destroyed, they would have to migrate southward. This seems to be just what did occur; the species migrated southward and southwestward of the area dominated by the ice.

As far as the major aspects of the present flora are concerned it matters very little whether there was one period

The conditions of the Tertiery era is recognized by most goologists as being a period of great terrain movement or change; mountains siready formed were modified, more rountains reared up by great crustal fluctuations and more land appeared stove the son lavel. Changing conditions had alleady produced greater adaptability of plant life to existing conditions as that the Anglosperme, watch had nor become downment almost everywhere, could notice stend further changing of conditions.

The Anglospersa seem to have oscone dominant sincet of everywhere of the everywhere of the everywhere of the object of the Obschol Period. This meriod is everywhit understood to have cook a time shan temperature and noiseway conditions permitted the formation of great ind absets which moved down over New Angland, New York, and the upper marks of the found effect upon versition. Indeed, if the apecies were not destroyed, they would have to migrate south and acutimestward of the area dominated and south south and acutimestward of the area dominated by the los.

halted one one erect tadade elittle you eredies it berreamed

of ice or whether there were several periods with intermittent short periods of floral re-occupation. Of course, consideration should be given to the probability that the various ice "invasions" did not cover the same area each time and hence in isolated areas vegetation representative of various periods of floral re-occupation might persist down to the present. The final recession of the ice sheet or its last "invasion" marked the beginning of the present day floral conditions in their major aspects.

No stretch of imagination is required to see the significance of the vast and effacing effects that an occupation of the land by heavy ice sheets would have upon the terrain. Previous covers of humus and rich soil often would be stripped off and be pushed into depressions, leaving bare rock in the higher places. A general disfiguring of the surface would result. Most of the lower hills were rounded off, for these would be more likely to be covered by ice, whereas the highest points may have escaped the ice covering. In fact, the possibility of peaks being missed by the ice has been suggested as a theory explaining the occurrence of Arctic vegetation on some of the higher peaks. Many huge deposits of rocks and boulders, with adjacent beds of varying gravel and sand, find explanation in no other way than through the disintegration of great ice sheets by the return of higher temperatures.

Thus we are confronted with the task of floral re-occu-

of its of whether there were neveral namical with intermitten short periods of floral re-occupation. Of course, consideration should be given to the probability that the various ice "invasiona" did not cover the same area sach time and nence in isolated areas vegetation representative of various periods of floral re-occupation might persist down to the present. The final recession of the los sheet or its last "invasion" marked the populating of the present day floral conditions in their major sapects.

No abroton of the vest and effected of each to see the stee of the vest of the vest of the vest of the service of the land of the land of the service of means and rice action have upon the terraine.

France, and be pushed into depressions, leaving here reder is the off and be pushed into depressions, leaving here reder is the officer places. A general distinguished of the antibace would not her of the leaver in the vere runneded off, for these would on more likely to us covered of its, whereas the highest points ray have essented the ice covering. In fact, the nest points ray have essented the ice covering. In fact, the content as a theory explaining the occurrence of arctic verescated as a theory explaining the occurrence of arctic verescated as a theory explaining the occurrence of arctic verescated and the blanch was and builders, with adjuste codes of verying everal and tasking of the first was and the department of the highest termination of meant for ancests of the return of higher termination of meant for ancests of the return of higher terminations.

-mana-ar fernil to keet and make herootikes are or summ

pation of a difficult terrain even though the forms could have been saved in the "ark" of a southern retreat. Newberry with mournful eloquence comments upon this return of the flora after mentioning the destruction of the Tertiary fauna.

"Hence, of the grand Tertiary fauna scarcely a remnant survived, while of the plants, when better days returned, and the snow fields and ice sheets retreated to Greenland, a sufficient number came back from their banishment to cover the central portion of the continent with a flora which retained all the essential botanical features of the Tertiary, but the vicissitudes through which it had passed had told sadly upon it. Many of its grandest and most beautiful elements had disappeared forever, while a few of its magnolias, tulip trees, sequoias and liquidambars survive as solitary representatives of the group to which they once belonged and form groves instead of boundless forests. Overtopping in their splendor, or outshining in their beauty present associates, they attest the general magnificence of those ancient forests that were composed of their progenitors and extinct relatives, their equals or superiors."1

In general the period of floral restoration can be noted as being the period from the close of the Glacial Period down to the advent of the white man in America and, in a part, down to the present. In this restoration we find a determined orderliness which can be and is modified by environmental exigencies, but even these interruptions or variations proceed with an orderliness more consistent than bookkeeping and more certain of resulting in a balanced condition.

nave been savet in the "art" of a conthern retreat. Newberry with mountain eloquence comments upon this return of the

"Hence, of the grad Teristry bane, when beter manual survived, while of the plants, when betser manual survived, and the show fields and test a

In remeral the period of flored readerston can de noted as formed the period from the close of the discipling the period from the share and in America and, in a down to the advent of the modern and in the restoration as flad a personal of the process of the moderniad by any vironmental existencies, out even these interruptions or variations proceed with an orderlines more consistent than bookseping and wore certain of resulting in a salanced condition.

#### B. General Topography of New York State

Geologically, the geography or topography of land is the result of all forces that have worked upon it and still continue to operate. We find the State of New York little affected topographically by man, but modified greatly in its surface appearance.

The whole state can be said to have two extensive elevated portions, the Catskills attaining a maximum of 4,205
feet and sloping down to the tide-affected Hudson and the
Bay of New York, and the Adirondacks reaching up to over
a mile above sea level on Mt. Marcy (with an altitude of
5,350 feet), the foothills of which slope down gradually
in the north to the St. Lawrence only a few feet above
sea level and to the Mohawk and Hudson in the south.

The topography of the state takes on several clearly discernable plateaus or basins on account of this altitudinal variation and the position of these two groups of mountains. On the east we find, running north and south, a basin slightly above sea-level, formed by the drainage of the Hudson and that of Lake Champlain. These two bodies of water come so closely together than a navigation canal connects the upper reaches of the Hudson with the Lake Champlain-Lake George system. About midway in this basin and striking off to the west, we have a slightly higher basin formed by the Mohawk River, reaching to a region just northeast of the Oneida Lake basin. The Mohawk basin is met on the west by the

declosing to require the recreation or topography of land is the result of all forces that have worked upon it and still continue to operate. We find the state of New York little affected topographically up sen, but modified greatly in its surface appearance.

The whole shade can be said to have two extensive elevated cortions, the Catawills attaining a maximum of 1,800
feet and slop my down to the tide-affected Hudson and the
Say of New York, and the adirondadks reaching up to over
a tile shows sas level on Mt. Karcy (with an altitude of
5,350 feet), the foothills of which slope down gradually
in the marth to the St. Lawrence only a few feet wood
ass level and to the Monawk and Mudson in the south.

The topography of the state takes on reverse of this eltitudinal discernacies plateaus or basing on account of this eltitudinal variation and the position of these two arcays of monators. On the sast we find, running north and south, a basin slightly know assalavel, formed by the drainage of the Hutter and that of lake Champlain. These two woules of water come to closely together than a navigation canal connects the upper recense of the Hutter than the lake Orugalain-Lake George system. About aldway in this basin and striking off to the west, we have a slightly bigher cash forard by the Hohawk work, reaching to a region just northeast of the Champlain. The Wohak basin is not the west of the Champlain. The Wohak basin is not the west of the

flanking northern reaches of the Lake Ontario basin which includes the Oneida basin on its eastward inland extension.

The Ontario basin extends westward to Niagzra and inland reaches south to the basins of the Finger Lakes. The northern reaches of the Ontario basin show no demarcation with the St. Lawrence basin which reaches up inland to the valleys of the northern slopes of the Adirondacks. To the southwest, the Ontario basin rises gradually to merge with the slightly higher Erie basin. These basins are often called Erie-Niagara-St. Lawrence and Ontario-St. Lawrence basins, but for ease of allocation we speak of them separately. We speak of the St. Lawrence basin as that part of the valley formed by the actual river St. Lawrence as it contacts New York State.

The Champlain basin is often called the Champlain-Richelieu-St. Lawrence basin.

Along the southern part of the state, neighboring
Pennsylvania, we find a generally raised plateau interrupted
from the western to the eastern part of the state by the
basins of the tributaries of the Alleghany, Susquehanna,
and Delaware Rivers. Thus we find the physical aspects of
the state determined by drainage away from the highest points
contained within itself. The largest similar or single region of the state, the Adirondacks, becomes contributor to:
the Hudson basin by drainage of the Hudson and Mohawk rivers
southward, the St. Lawrence by drainage of the Black,
Oswegotchie, Grasse, and St. Regis rivers northward, and to

Floring northern reserves of the land Onterto basin which includes the Cheste basin extends westward to Mierra and inland reaches doubt to the basins of the Finger Lebes. The northern reaches of the Onterto basin show no demandation with the ern reaches of the Onterto basin show no demandation with the the porthern slopes of the Adirondacia. To the acuthwest, the Conterto basin rises gradually to menor with the acuthwest, it of Conterto basin rises gradually to menor with the acuthwest. It is content and Conterto-5t. Lawrence basins, but for ease of allowation we special of them separately. We speak of the actual river St. Lawrence as it contacts New York State.

The Champlain casin is often called the Champlain-Richalicutat. Lawrence heals.

Along the southern park of the state, neithering formsylvania, we find a generally raised clateau interrupted from the western to the sattern part of the state of the the object of the state of the object of the state of

the Champlain basin by the Saranac and Ausable rivers east-ward. As will be brought out, these basins operate to permit inclusions of flora which on a general plateau in the area would not be found. Close analogy of frost-free days to altitude will also be seen.

. Heet be paid life aboution of

#### II. Xerophytic Succession in New York State

The whole state of New York has already been described geologically as being a glacially-prepared terrain. Features would rather frequently occur offering plant habitats deficient in water supply. There are several types of such habitats, outlined as follows:

- 1. Surfaces of bare rocks as glacial stream beds, rounded dome-like summits of hills and mountains in the Adirondacks, the Catskills, Hudson Highlands, vertical sides or ledges of mountains, and deeply cut stream beds.
- 2. Accumulations of rock fragments and mounds or areas of round boulders deposited by melting ice.
- 3. Sand deposits, dunes, deltas, lake shores, and glacially-distributed sands of the Adirondack rock which is largely gneissic.
- 4. Exposed hills and slopes consisting largely of gravel and sand or with a very thin cover of till.

In the first two of these conditions, fissures and spaces or pockets permit the lodging of sediment, both mineral and organic, and the holding of water, thus encouraging vegetation. Steady seepage may even promote an almost hydrophytic condition, as is the case in many of the mountanside swamps in the Adirondacks.

In the third case the development of the heath-shrub climax is indicative of this previously prevailing condition.

# II. Xarophytic Juneouston in New York State

The whole state of New York has elready been described geologically as Wein: a glacially-prepared terrain. Pastures would rether irequently occurroffering plant habitats de-frieient in water supply. There are several types of such nabitats, outlined as follows:

- 1. Surfaces of care rocks as clacked atreem beds.

  rounded dome-like summits of bills and rountains in the
  adtronducks, the Cataville, Andron Sirilands, vertical sides
  or ledges of mountains, and deeply out stream beds.
- E. Accumulations of roc. fragmonts and mounds or erect.
  - 3. dand deposits, dunes, deltas, lake inords, and glacially-distributed sands of the Adiroudses rock which is isrgely quelasic.
- A. Happesed hills and slopes consisting largely of gravel and sand or with a very tain cover of till.

  In the first two of these conditions, fisheres and spaces or nockets permit the locates of sediment, coth mineral and organic, and the belding of water, thus encourage ing veretation. Steady seepage may even promote an almost nydrophytic condition, as is the once in many of the recontraction of the Adrendacias.

for the third chie the devel pment of the baste-shrub cultures is indicative of this proviously proveiling condition.

In the last circumstance, mesophytic conditions finally permit the typical well-developed forest vegetation, if not the forest climax.

In Figure 1 taken by the writer on the heights of
Whitehall, New York, we see the climax of mesophytic conditions which developed from a Xerophytic habitat of the first



type. Various red and black oaks of no large size are mixed with service-berry, birches, and maples, both hard and soft; the white pine does not reach the handsome size it does on deep soil. The ground cover is shrubby, being composed of various blueberries, sweet fern, bracken fern, columbine, various saxifrages, strawberry, cinquefoil, and occasional patches of wintergreen.

Figure 1
In the vicinity of Saranac there are many rocky promontories which must have been bare rock. At present various stages or successions under typical conditions are observable. In general, many of these areas are covered with sugar maple, yellow birch, beech, hemlock, paper birch, red spruce and a varied forest floor, or general conditions of floral zone 3 overlapped by some indicators of the Canadaian Transition floral zone. (Floral zones will be discussed under

In the lest circumstance, mesophytic conditions finally nermit the typical well-developed forest verstation, if not the forest circum.

In Figure 1 taken by the weiter on the holphts of whiteness, New York, we see the climan of memorytic conditions which developed from a Morophytic habitat of the first

type. Various red and black cake of no large size are rixed with service-berry, birones, and maples, but hard and soft; the welte pine does not reach the handsome size it does on deep soil. The ground of various bluquerries, sweet ferm, bracked ferm, columbine, warlons assifrages, strawborry, cinquefoll, and occasional patches of winter-

Flanne I

In the vicinity of Service are such that the promontories which must have been their root. At present various
stages or successions under typical equilitions are observable.

In general, many of these areas are covered with anger maple,
yellow bires, been, femines, perer sires, red apruce and a
varied forest floor, or general conditions of floral sone 5
everished by some indicators of the damadsien Francisco
literal sone. (Floral sones will be discussed under

Mesophytic Succession or Extension in New York State.) The process of occupation of bare rocks by vegetation is common ecological information, the succession of crustose lichens, foliose lichens, mosses, small flowering plants, woody plants, small shrubs, larger shrubs, and the vanguard of forest species eventually bringing on the limited climax of hard-woods (limited by soil depth).

Sand offers the most interesting development of the xerophytic type of terrain. The appearance of sand flats in New York State points geologically to a time when the Mohawk, Hudson, Saranac, and Balck rivers emptied at a much higher level than they do now. These rivers now continue far past what was once their deltas. The writer has observed the great sand bed country of Great Bend on the Black River. The river now extends on down to Lake Ontario, cutting through vast layers of limestone and, lower down, nearer the level of Lake Ontario, slate. On the sand beds referred to, white pine stands of good size indicate the original climax. On the plans off the sand beds we have the clay beds of old Lake Iroquois which support a thinned-out mixture of zone 2 and dominants of zone 3. (See Figure 12).

In the case of the Plattsburg Sand Plains we have a condition very similar to the Black River Sand Beds. However the sand flats persist all the way to Lake Champlain, the Plattsburg beaches being one of the greatest inland or

Mesophytic Succession or Extension in New York State.) The process of occupation of bare rocks by vegetation is common ecological information, the succession of crustose lichens, mosses, small flowering plants, woody plants, and the vanguard of forest spacies oventually bringing on the limited of forest woods (limited by soil tepts).

Sand offers the most interesting development of the xerophytic type of terrain. The appearance of sand flats in New York State points geologically to a time when the Mohawk, Bodson, Saranac, and Salok rivers emptled at a tuch higher level toan they do now. These rivers now continue far past what was once their deltas. The writer has on-served the great and bed country of Great Send on the Elsek fiver. The river now extends on down to Lake Ontario, outting lavel of lake Ontario, slate. On the sand beds referred to, white pine stands of good size indicate the order down, meaner to, white pine stands of good size indicate the order calay seds of old lake Iroquois which surport a thinned-out mixture of sone 2 and downants of rose 5. (See Firme 12).

a condition very similar to the Black Hiver Sand Seds. How-



Limestone beach occurs between the reaches of sand bed formations of the deltas of the Saranac and Ausable rivers. The Plattsburg Sand Beds have a larger area of less luxuriant growth than most of the other sand areas of the state. The most conspicuous forms are semidense stands of gray pine or banksiana (see Figure 2) and pitch pine (see Figure 3). Photos were

Figure 2 taken some thirty miles apart on the Plattsburg Sand Plains. Associates of these are white pine (mixed with hardwoods in

mulated loam), scrubby red oaks, fire cherry, service, berry, and common poplar. The ground cover is largely composed of various kinds of blueberry, shrubby service berry, sweet fern, lamb-kill, wintergreen, and various other small heaths and bracken fern.

This region is, in general, a dryer region than the other large sand areas of the State. Figure



Figure 3

Preshwater beaches in America.

Limeatone beach occurs between the reaches of sand bed formations of the deltas of the Serance and Ausable rivers. The Plattaburg Sand Beds have a larger area of less luxuriant growth than most of the chief and of the analy conspicuous forms are sanddense stands of gray pine or bank-dense stands of gray pine or bank-stand (see Pigure 2) and pitch pine (see Pigure 2) and pitch

taken acre thirty miles spart on the Flattsburg Send Fielns.

Associates of those are white pine (mixed with narywoods in small areas of more deeply accumulated icam), serubcy red caks,

fire cherry, service, servy, and

common poplar. The ground cover

is largely composed of various

wintergrees, sweet ferm, lame-kill,

wintergrees, and various other

sand areas of the State. Figure



Figure 4

4 illustrates a condition found over large areas of the Plattsburg Sand Plain.

Another type
of sand bed succession or climax is
found along the

shores of Lake Iroquois, the old parent of Lake Ontario. The rim or shore of this is now occupied by the "Ridge" Highway, given over to fruit-farming, and having only scattered small areas indicating the conditions of zone 2. Near Rochester, along the shores of Lake Ontario, we find conditions of hydrophytic succession on the otherwise xerophytic sands. Examples of this are the cut-offs of Irondequoit Bay and the marsh meadow of Charlotte. The most typical xerophytic development on sands of this area is found on the shores of Lake Oneida. Here Bray<sup>2</sup> describes Polytrichum mats with sparse vegetation of leather leaf, after which black chokecherry and witherod occur sparingly. Pioneer forest is followed by thickets of gray birch and smaller amounts of aspen.

The "Plains" of the upper Oswegotchie present yet another sand development. These plains are unique in their definite lines of demarcation from regular forest. But the forest is (with a narrow margin) creeping out by regular

dition found over large areas of the Plate.

Another type
of and bed succession or climax is
found along the

Pigure 4

shores of lake Iroqueis, the old parent of lave Catario. The rim or shore of this is now accupied by the "Hidre" Highway, even over to irult-farrion, and having only scattered email areas indicating the conditions of zone 2. Hear Rochester, along the shores of laws Catario, we find conditions of hydrophysic saccession on the otherwise xerophysic sands. Stangles of this are the out-offs of Irondequoit day and the march meadow of Charlorge. The coat typical xerophysic development

of cray birch and smaller amounts of aspen.

The "Helen of the upper Cause plain are unique in their and another and development. These plains are unique in their serior and the line of demarcables from requier forest. But the range is (with a namew margin) creciler out by vegular

succession onto the open plains led, strangely enough, by tamarack, an indicator of bog conditions. The open plains are essentially a heath formation with progressional stages from Polytrichum to small shrubs such as various species of blueberries (the writer has picked blueberries in abundance), followed by creeping blackberry and larger heathshrubs up to the invading tamarack and black spruce. This mingling of typical sand barrens and typical bog is unique, inviting study. (Bray<sup>2</sup>)

The most interesting of sand areas is the northern extension of the New Jersey pine barren flora on Staten Island and Long Island. The famous pine barrens of New Jersey extend with few interruptions from the Lower Bay of New York to Cape May and the mouth of the Delaware River. Its northern portion is a narrow belt near the Atlantic coast, but it expands as it extends southward so as to include nearly all of southern New Jersey. The flora of this region includes many of the most beautiful plants of North America. (Britton<sup>3</sup>) The soil of this area is generally extremely sandy, but it is occasionally more firm in places where strata of clay approach and form the surface.

The pine barrens of Staten Island and Long Island are a northern extension of the sandy stretches of Cretaceous Age. Much of this northern extension is covered by Glacial Drift deposits. Of the characteristic plants of the pine barrens, there are thirty-four appearing on Staten Island

succession onto the open plains led, strangely enough, by temarack, an indicator of bog conditions. The open plains are essentially a heath formation with progressional stages from Polytrichum to small amube such as various species of blueberries (the writer has ploked blueberries in abundance). Pollowed by creeping classicary and larger heathermus up to the invading temarack and black apruce. This mingling of typical send servens and bypical bog is unique, inviting study. (Sray?)

The most interesting of sand areas is the northern extension of the New Jersey plus barren flora on Staten Island and Long Island. The famous plus berrens of New Jersey extend with few interruptions from the Lower Bay of New York to Cape May and the mouth of the Delaware miver. Its northern portion is a narrow belt near the atlantic coast, out it expands as it extends southward as as to inalmic nearly all of southern New Jersey. The flora of this region includes many of the most beautiful plants of Morte America. (Brittens) is occasionally more firm in places where atface of clay is cocasionally more firm in places where atface of clay

The plue perrens of Stetes Island and Long Island are a northern extension of the sandy stretches of Cretaceous age. Much of this northern extension is covered by Placial Drift deposits. Of the characteristic plants of the pine berrens, there are thirty-four appearing on Statem Island

and Long Island are found in New England. (Britton<sup>3</sup>) However, Britton has not taken into consideration the fact that a number of these characteristic sand barren plants are found on the mainland up the Connecticut coastal plain, Cape Cod and even as far north as Nova Scotia in Canada and on the western coast of the island of Newfoundland.

Bray considers the flora of the sand areas essentially the same except for the modification of surrounding dominating floral zone types. The Oneida Lake sand flat, where Polytrichum and leather leaf are dominants, and the "plains" of the upper Oswegotchie, where lichens and Polytrichum constitute the main ground cover, suggest an interesting comparison with the pine barren and heath formations of Northern Germany. (Bray4)

The soil conditions on sand areas are in general very similar. The following is a sketch illustrating the layers the writer has checked in several sand bed areas about the

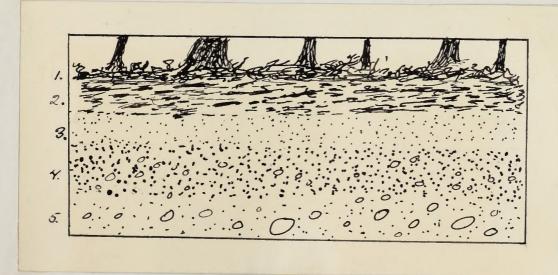


Figure 5

and Long Island are found in New England. (Sritton ) However, Britton has not taken into consideration the fact
that a number of these characteristic ased berren plants
are found on the mainland up the Connecticut coastal plain,
Cape Cod and even as far north as Nova Scotia in Canada and
on the western coast of the Island of Newfoundland.

Bray considers the flore of the send areas essentially the same except for the modification of surrounding dominating florel zone types. The Oneida Lake send flat, where Folytrichum and leather leaf are dominants, and the "plains" of the upper Cawegotenie, where litthens and Polytrichum constitute the main ground dover, august an interesting conperison with the place barres and heath formations of Northern Jermany. ( Bray !)

The sold conditions on sand areas are in penetral off relimine and Junde sand had been prevent in belond and retire off

Adirondacks, varying a little in some cases, but in general holding quite true. Layer number one varies in depth but consists of vegetable matter just in the beginning stages of decomposition. The second layer varies in thickness necessarily as the first layer varies in amount. This is the layer of partly to thoroughly decomposed organic matter. The third layer of fine gray sand is three to six inches thick. Beneath this is a varying layer of blackish sand stained by organic and decomposed mineral matter seeping down. Below this is the "bed" of varying yellow sand and mixed gravel. Tree roots come well down into the "bed", probably for water, but they also have peripheral roots in the third and fourth layers.

defining the base. Layer miner one writes in death but to be death but to be selected by the base of wickers and not to be writes in death but to consists of wickers and to be red to be selected and consists of the second of the selected and the selected and the second of selected and the selec

### III. Hydrophytic Succession in New York State

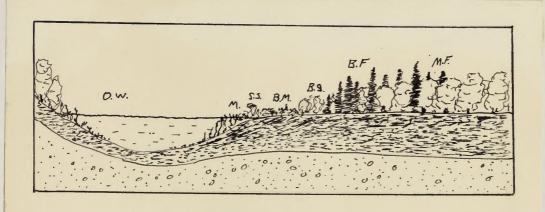
The coast line of New York State is limited to that part of Long Island not yet occupied by industrial and recretional beaches, so far as natural ecological development is concerned. The most of what is known of the flora of the cosmopolitan New York area is from recordings of rather long standing, preceding the rapid development of the city area. The shores of Lake Erie and Lake Ontario have the proportions of sea shore without the same proportions of bodies of water that are as brackish as regular sea shore. The many lakes of the Finger Lake region and the mountain region of the Adirondacks have areas of "Cut-offs" from the main body of water where vegetation is undergoing the regular hydrophytic suc-There are also many "kettle-hole" ponds scattered over the state. These "kettle-holes" in the heavily wooded areas usually are strongly acid bogs, no doubt owing to the large amount of decaying and undecayed vegetable matter plus chemically strong seepage into the ponds. Where these small ponds occur in more cultivated areas and less heavily wooded areas, we find the more typical shore succession of plant life.

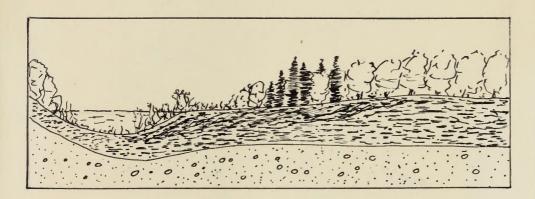
Figure 6 is a diagram showing the usual process of mesophytic development from hydrophytic conditions. This diagram is based upon general discussion and description of bog and forest formation over water areas. The figure is of

# III. Hydrophytic Succession in New York State

bearing, so for as natural ecolorical development is concerned . Enipose to long render to employees or sere drow well preceding the rapid development of the city ares. The shores and of makes dead on , and blos gironts one glisses esens

Pigure 3 is a diagram abowing the want process of mesophytic development from hydrouhytic conditions. This diagram is based upon general discussion and description of mes and forest formation over water areas. The livere is of





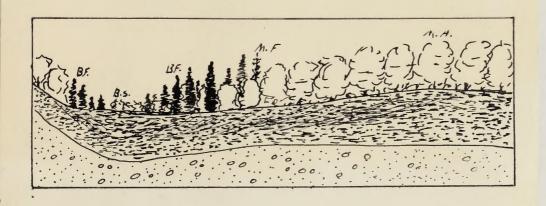


Figure 6

Diagrammatic representation of succession from open water to Mesophytic forest. O.W.--open water, M.--marginal succession, S.S.--shore succession, B.M.--bog meadow, B.S.--bog shrub, B.F.--bog forest, M.F.--mesophytic forest, M.H.--mixed hardwoods. Suggested by A. Dacknowskil4 in "Geological Survey of Ohio" Bull. 16, Columbus, Ohio, 1912.

## Pigure 6

Diagrammatic representation of subdession from open water to Mesophytic forest. C.E.--open water. M.--merginal succession o.S.--anore succession, B.M.--bog mesdow, B.E.--bog forest. M.F.--mesophytic forest, M.F.--mesophytic forest, M.F.--mesophytic forest, M.H.--mixed bardwoods. Sungasted by A. Dacknowskill in Ideological durvey of Onio Buil. 16, Columbus, Obio, 1012.

typical conditions where the amount of water or "water table" could become incorporated in the newly forming duff without leaving an excess of water which would produce a stagnant bog which would seldom if ever become fully adjusted to mesophytic conditions.

In some cases lakes have certain periods of "blooming", a period when colonies of minute algae form plentifully and rapidly. Good examples of these are Conesus Lake near Rochester, and Oneida Lake. The writer has noted how this occurrence in these lakes has produced thick layers of scum on the surfaces of quiet bays, scum which by heavy wave action is often cast up on shore, becoming incorporated with the organic matter of the shore soil. These lakes (and wherever this condition would prevail) are found to have a fine, yellow-peat-like structure to a considerable depth below the turf. Also the bottom becomes covered with an ooze-like sediment from the decaying and settling of this matter. This is not overlooking the fact that animal plankton contributes substantially to lake-bottom sediment, for the presence of peat-like material is evidence of vegetable origin. Bray2 lists duckweeds of the Salviniaceae of the Pteridophytes and liverworts of Ricciaceae of the Hepaticae among the floating plants in New York lakes. Potomogetons form the bulk of submerged plants in many lakes.

Graham and Henry<sup>5</sup> report an interesting behavior of shore succession from observance of fluctuation of Deep

typical conditions where the smount of water or "water table" could become incorporated in the newly forming duft without leaving an excess of water which would produce a starnant bog which would saldom if ever become fully adjusted to mesconytic conditions.

rapidly. Good examples of chesc are Coroses Lake near with the organic matter of the shire soil. These lakes dit betaven compact median the only . Thus and woled disget . serial word wolf of ashabe anistoff and proma againaged

Pond near Wading River, Long Island. From 1926 to 1933 this lake had various water levels. It had sunk steadily a few years, in 1927 it rose rapidly, then thereafter sank steadily. The lake's level is regulated by the mean water-table of the land. A two-year lag in height over seasons of heavy rainfall is conspicuous. The lowest level recorded is two years belightest rainfall. The border strip of new shore. left from each year's dropping of the water level. exposed plants of the submerged type. Of these, only those more adaptable to exposure remained as the more land-loving plants that border water crept down from the ring of vegetation to the landward and proceeded to coccupy the new strip. This progression year after year from the landward side resulted in forming very observable "rings" of societies down to the water's edge. The sudden high water drowned out the land plants not adaptable to submergence, most conspicuous of which is Pinus rigida. Farther back on shore at another period dead Pinus rigida indicated an even higher flooding. This is a good illustration of the advance and retreat of vegetation along lake shores. But the filling in of cut-offs is more definite and permanent than lake shore fluctuation. Figure 7 shows an example of what often happens to a small brook. A flooded area is invaded by cat-tail followed by iris, after which alders form a firmer mat and offer raised hummocks where even white pine can take a stand. Figure 7 shows dominance of white pine on higher soil. This photograph was

Pond near Wading Hiver, Long Laland. Prom 1925 to 1935 this we'l e gilbaeds while had il . slavel rater spoints bed exel Italitar years to emerge tevo Jacied al pal may-owt & . baal -ed arest ows al bebroom level deawel off . avoudiganos el .erode wen lo often related . Lielander thesial end both water's edge. The sudden high water ducumed out the land is Plans rigids. Farther back on shore at another reriod dead a commed beater wello had demissionally much stable doldw where even white pine can take a stend. Ideure ? shows



Figure 7

taken in a depression of the general Platts-burg Sand Plains.
Figure 8 shows the persistence of vegetation in returning to its own habitat and producing mesophytic

conditions. This pond has been under the writer's observation for over twelve years. First, some beavers made a dam on a small brook. The water flooded out a stand of balsam, red, white, and black spruce, and even tamarack. The C. C. C. cleared away the old beaver dam, cleared off the dead trees and made a pond. The "bar" in the middle of the pond was just below water level, with cat-tail growth coming above water level. Since 1932 this bar has emerged and become covered by cranberry as a result of the mat-forming activity of the cat-tail.

The great muckfarming area of

Montezuma swamp presents every indication
of having been built
up by the mat-forming
activity of cat-tail
and its associates.



Figure 8

taken in a depresation of the general Platts.

burg Send Plains.

Figure 2 shows the generals that the producing to the returning to the standard to the producin muscobytic.

Picture 7

conditions. This pend has been under the writer's observation for ever twelve years. First, sore beavers made a dam on a small brook. The water flooded out a shand of below, red, white, and black arrace, and even tenared. The C. C. C. cleared away the old beaver day, cleared off the dead trees and made a pend. The "bar" in the middle of the cond was fust below water level, with out-ball crowth applications covered by cranterry as a result of the cat-toring activity of the cat-tail.

- Join Jacky odl

lo some entered -ero pre- pre- lodication of new some built, of new built, to principle the set-forming the set-loses.

E OTHER

The writer has noticed with interest the broad waving cat-tail acres in the region of the Montezuma swamp here and in the Irondequoit Bay near Rochester. Back of the cat-tail comes an invasion of shrub willow and equisetae followed by ferns, building up a muck turf.

Another type of muck-farming area in Cicero's swamp south of Lake Oneida presents a different type of succession. Bray6 reports findings of built-up soil of clear peat and occasional marl beds down to a depth of at least thirty feet. Obviously this great depth was formed as the result of obstructed drainage. The succession here was probably from open water vegetation stages to Sphagnum containing grass and sedge marsh, to smaller, heath shrub and later to high shrub (high-bush blueberry, mountain holly, choke cherry, etc.). The swamp forest stage here is now conspicuously dominated by white cedar, tamarack, and black spruce although red maple is common also. The natural succession of this area is now being upset by agriculture. In the western part of the swamp the natural succession is being maintained where a free drainage channel has been kept open by natural means. But with the probable exception of the Adirondack mountain area, swamp forests in New York in general don't have such simple sequence. Settlement of the country removed much of the swamp forest, the drier areas being tilled, the wetter areas reverting to marsh meadow. Along streams willow and alder have developed a reversion to the shrub stage

The writer has noticed with interest the broad waving cat-tail acres in the region of the Contetums swamp here and in the Irondequoit Bay near Rochester. Back of the cat-tail comes an invasion of shrub willow and equisetse followed by ferms, building up a muck turf.

. Jeel yathit tensi te lo nigeb a or myob shed fram Lanolasnoo

which is often found to have been invaded by soft maples followed by ash and some elm.



Figure 9

Figure 9 shows a type of development from hydrophytic conditions which will arrive at Mesophytic climax only after great delay. Photo was taken near Saranac Lake in a pocket-like area between promontories of the type already described. Occupying the center of the bog are various heath plants bordered by tamarack, balsam, and black spruce. Interesting to note was the fact that in spite of the difference in size the tamarack and other conifers near the middle of the bog are very little younger than those farther back in conditions more favorable for growth. This indicates a probable acid condition of the bog water that retards growth. The stand of conifers on the left gives way to a climax of white pine on a slightly elevated ridge or esker of sand. This is probably a glacial "kettle hole".

which is often found to have been invaded by soft replet

### Figure 9

Figure 9 shows a type of develope ent from hydrophytic conditions which will arrive at Mesophytic climax only after great delay. Photo was taken near Saranac lake in a pockettike area between promontories of the type already described. Occupying the center of the bog are various heath plants cordered by temarack, balann, and black aproce. Interesting to note was the fact that in spite of the difference in site the temarack and other confiers near the siddle of the bog are very little younger than those farther back in conditions more favorable for growth. This indicates a probable acid condition of the bog water that retards growth. The stand of the mos water that retards growth. The stand of a slightly elevated ridge or eaker of sand. This is probably a slightly elevated ridge or eaker of sand. This is probably a slightly elevated ridge or eaker of sand. This is probably a slightly elevated ridge or eaker of sand. This is probably



Figure 10 illustrates
a common development
or relationship of bog
and mesophytic forest
climax. The brook has
been forced to deepen
by the action of turf
formation by plant

Figure 10 development. The bog shrub stage gives way to typical bog forest which in turn is invaded by mixed hardwoods.

Figure 10 illustrates a common development or relationship of bog and mesophytic forest olimax. The breek has been forced to deepen by the action of turf formation by plant

Figure IO
development. The bog shrup stage gives may be typical bog
forest which in turn is inveded by mixed mardwoods.

## IV. Mesophytic Extension in New York State

#### A. Factors of Climax Growth

Ecologically the whole state must be called Mesophytic, a condition of regulated water maintenance sufficient for the needs of luxuriant growth and having capacity features for the disposal of excess water. It is, in other words, a condition of adequate supply of water and drainage consistent with adequate growth. In general, mesophytic conditions evolve from or are the climax of either xerophytic or hydrophytic succession. Thus the interpretation of mesophytic conditions by following the succession from xerophytic or hydrophytic conditions is aided by an understanding of what probably produces mesophytic conditions. Of course, there is possible a direct mesophytic climax upon terrain ideally provided for such development. Vegetation itself tends to produce mesophytic conditions. This is clearly seen in either development already considered. If the humus content of any tilled area leaches out or is consumed, the area may become dry if its former condition tended toward a xerophytic order. Or, if its former condition were hydrophytic, it will become wet and acid. Thus we can see that vegetation itself has more to do with producing mesophytic conditions than any other one factor. It is in light of this understanding that the writer purposely delayed the consideration of factors most directly affecting plant life and the consideration of

## IV. Mesophytic Extension in New York atate

A. Factors of Climax Growth

the disposal of excess water. It is, in other words, a conwith adequate growth. In general, mesophytic conditions physic succession. Thus the loterprotetion of mesophysic produce mesophytic conditions. This is clearly seen in citner To Justinos agram ent II .bereblenco goserla juengoleveb order, Or, if its former condition were hydrophytic, it will least noiseday ferd one mes ow and . blog but few emosed any other one factor. It is in'llent of this widepatanting

floral distribution or zonal indication until the means of understanding them were portrayed.

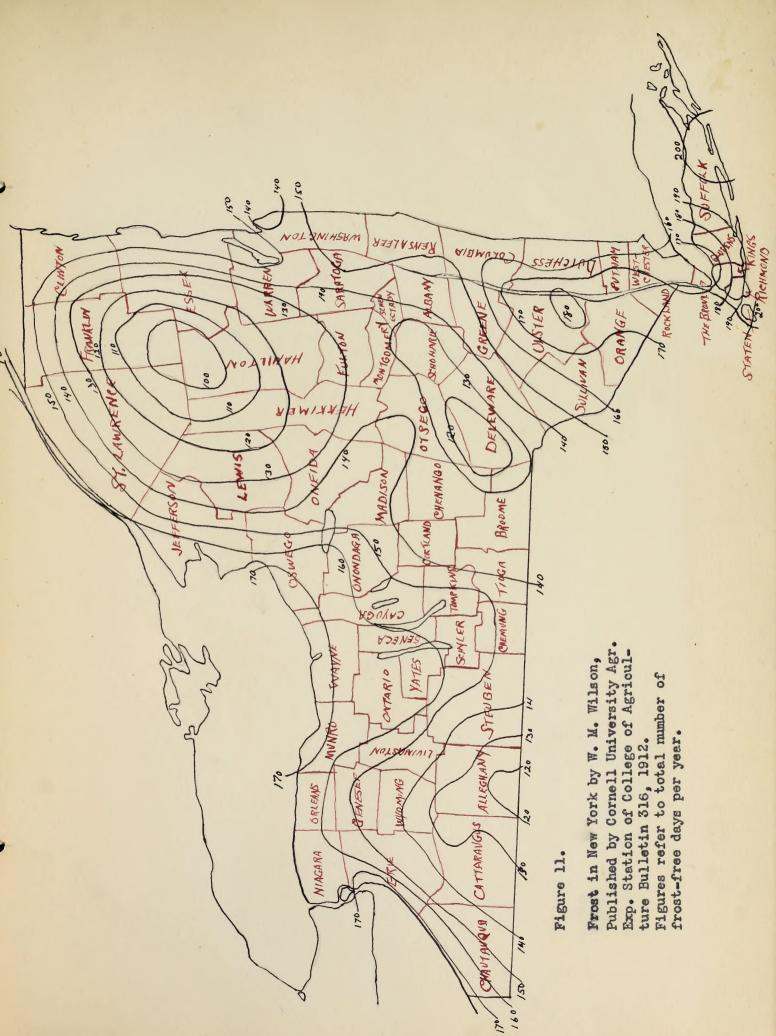
Light becomes a limiting factor in the mesophytic forest. The difference of ground cover in a deciduous forest with a great variety of leaf shapes admitting larger amounts of light to the surface is vividly in contrast to the thick, coniferous forest with so little light on the soil that few forms develop there. It is consistent with this natural fact that seedlings of young conifers develop at their optimum in more shade than do those of deciduous plants. Many plants have developed this capacity of shade tolerance to such an extent that they require partial shade for their optimum growth and clearing away of the climax growth of overhead forms does away with many of the ground cover forms. Light is associated with heat and the larger amount of light, and thus also heat, is consoicuously shown in its effect where slopes with a southern exposure are contrasted with definitely northern slopes as to floral society and development.

Light is not the limiting rod of measurement of heat, for the effect of altitude variation is shown in spite of same amounts of light. Study Figure 11 and notice how that in the basins which often are farther north than some southern parts there is a much longer period of total frost free days per year. (Wilson<sup>7</sup>) This total yearly temperature has much to do in determining the type of floral climax possible.

To ansem odd Lidnu notisolbni lano, to notispittelb latelt .beyering ever medd anthustaretim

The difference of round quoter in the mesophytic forest. The difference of round quoter in a decidence force with a great variety of leaf shapes sanitating larger amounts of light of the surface is vividity in contrast to the thick, configrous forest with so little light on the soil that few forms davelop forces with so the soil that few forms davelop then. It is considered with this satural fact that seedlings of young configra develop at their optimum is more shade than do those of decidence plants. Many plants have developed this quire partial shade for their optimum growth and clearing quire partial shade for their optimum growth and clearing many of the climax growth of outside forms does also sand with meat and the larger amount of light, and thus also heat, is completely shown in the slopes with a southern san contrasted with definitely borthern slopes as to rioral society and development.

Ident is not the limiting red of measurement of hont, for the effect of slitting variation is shown in spite of sime amounts of light. Study Figure II and notice how that in the hastna which often are farther north than some southerd parts there is a much longer period of total front from days per year. (Wilson') This total yearly temperature has much to do in determining the type of florel climax possible.



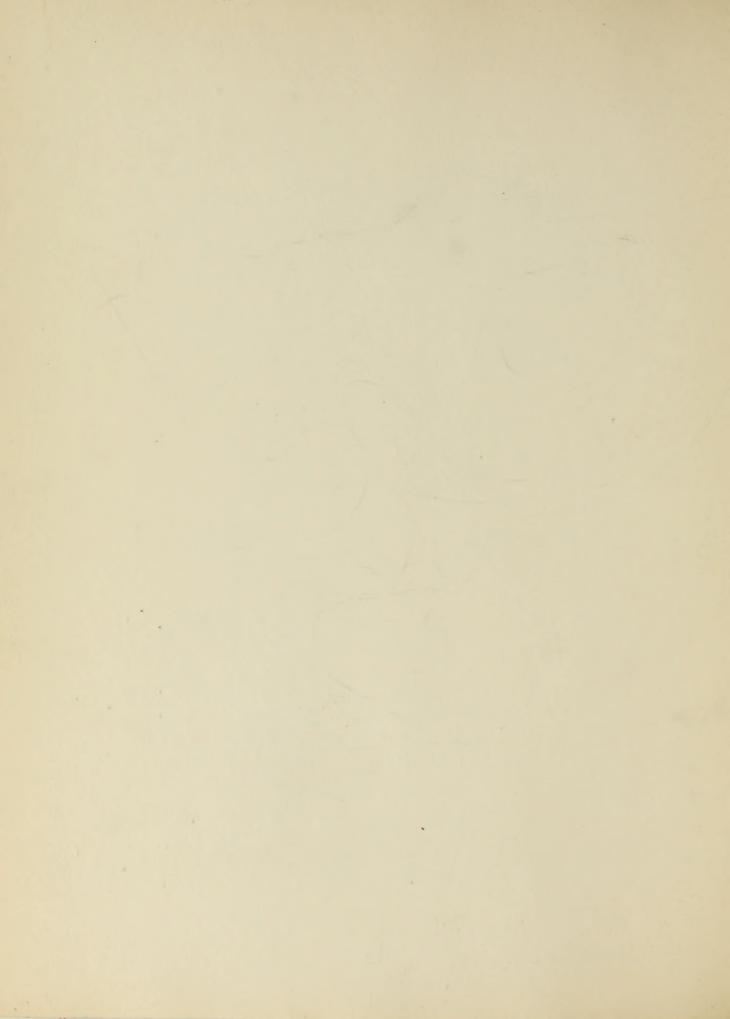


Figure 12 shows the mean temperature per year of the State of New York. Comparison with Figure 11 shows a rather close correlation between the total frost free days per year and the temperature mean. Further comparison with Figure 14 shows the close correlation between the total frost free period per year (which represents the growing period), the total mean temperature per year (which loosely represents the optimum temperature for any area) and the type of floral climax found in any sizable area. Thus in the Ontario Lake Basin and the larger part of the Hudson River Basin where the total frost free period averages one hundred fifty to one hundred seventy days, and the temperature mean for a year averages forty-five to fifty degrees, we have a floral climax of the Upper Austral type (Zone 2) indicated by the frequency of chestnut, oaks, and hickories. Similarly, we observe in the Long Island region where the total frost free period reaches as high as two hundred days with an annual temperature mean of fifty to fifty-five degrees the typically Austral flora with more southern species of persimmons, sweet gum and willow oak. Other interesting similar comparisons are to be made in the Adirondack Mountain area, the Catskills and the Alleghany shed.

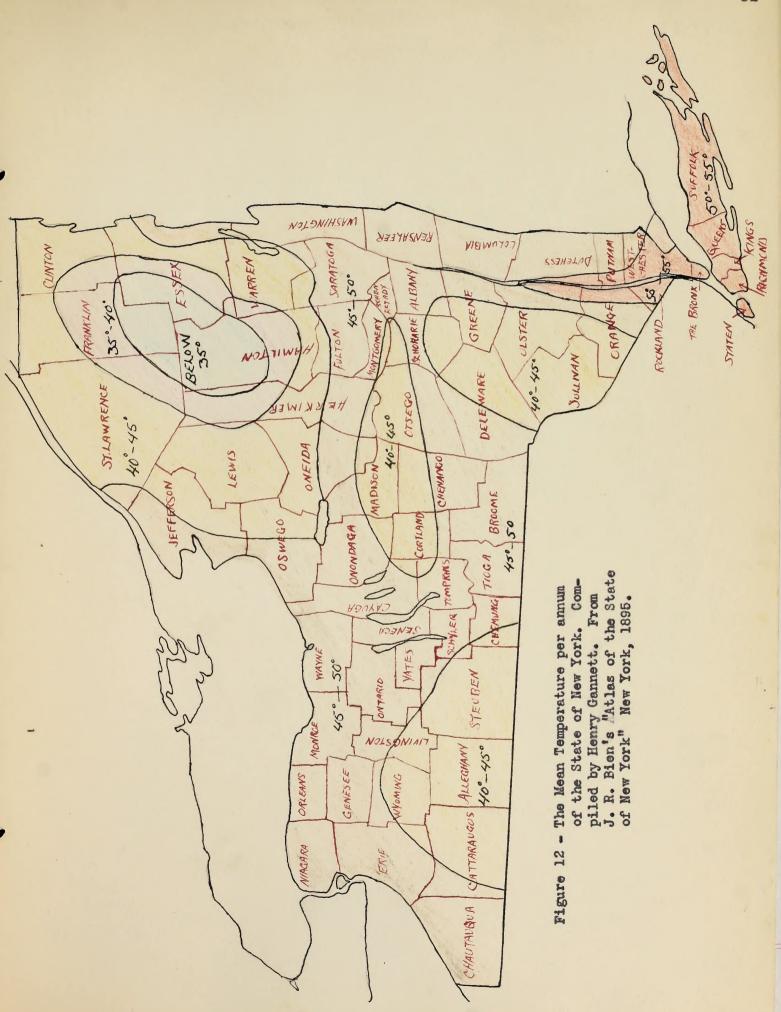
The relationship between available moisture or water supply and the type of vegetation has already been discussed under hydrophytic and xerophytic conditions, but the emphasis on the relationship was from the viewpoint of in-the-soil condition. Figure 13 shows the mean rainfall in inches

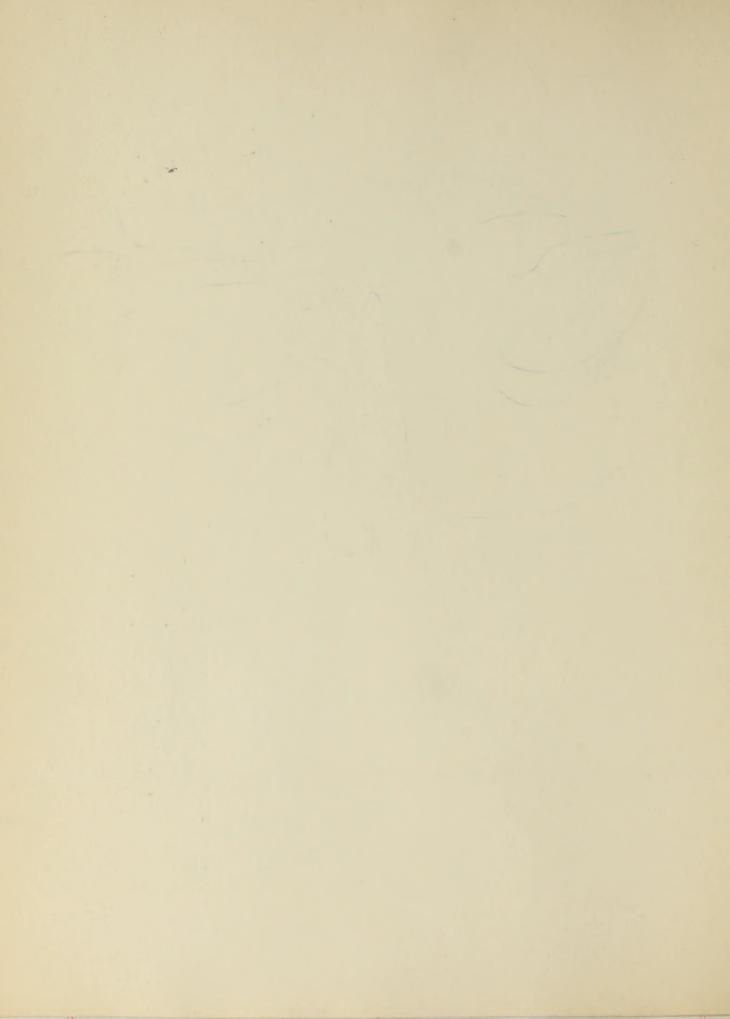
State of New York. Comparison with Firmer 11 shows a rather and the temperature mean. Further comparison with Figure 14 and . (bolves uniwors end admessages doling) reay may may beine climax found in any sizable area. Thus in the Cotorio lake averages forty-flye to fifty degrees, we have a floral climax of chestaut, cake, and hickories. Similarly, we odserve in mur Jeers' . smortisted to selects madding aron dilw aroll and bne Alleghany shed.

The relationship netween available moisture or water supply and the type of vegetablen as already been discussed ander hydrophytic and xerophytic conditions, but the ser pinals on the relationship was from the viewpoint of in-the-sell condition. Figure 13 shows the mean reinfall in inches







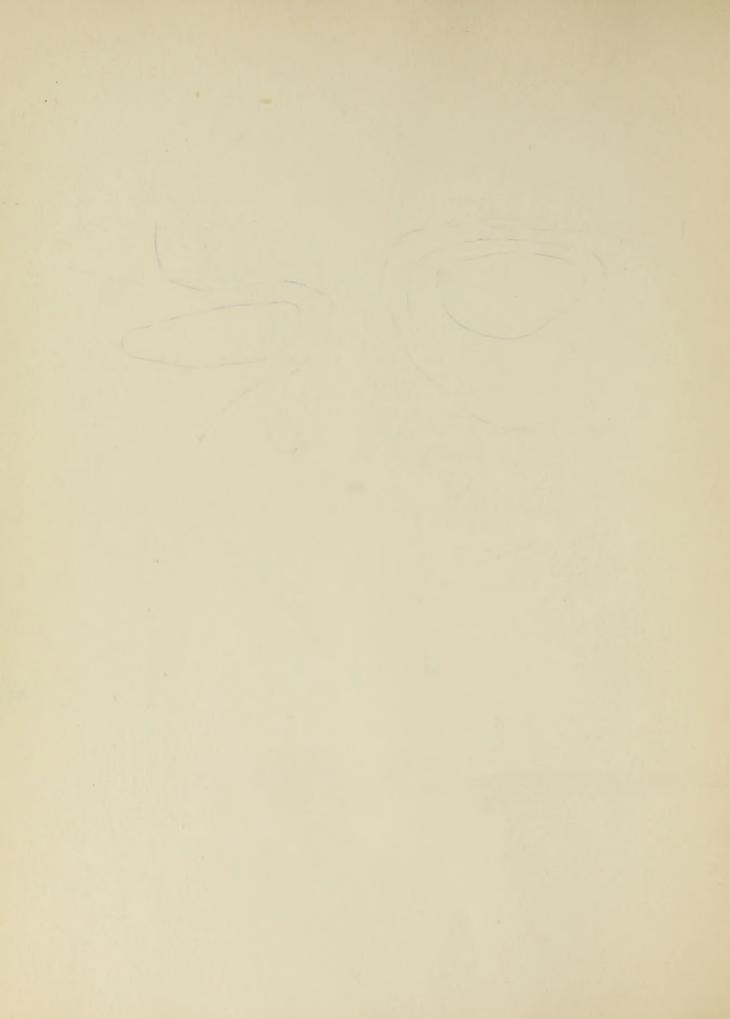


per year in New York. We find a variance of over twenty inches of rainfall within the state. We observe a similar distribution of rainfall and floral conditions, but we notice the modification by other factors. It is not enough to say that in a given area the more the rainfall (within optimum limits) the greater will be the vegetation. The very factors that to a large extent are responsible for an increased rainfall also serve to delimit the type of floral climax. In the southern part of the state much more uniformity of rainfall exists than uniformity of vegetational climax. In a transect from the Catskills to Long Island, a distance of one hundred miles, we find all the variance between climax of the Canadian or boreal type and climax of the Austral type. Similar conditions exist over a transect of one hundred miles from the Mount Marcy region to the Hudson-Mohawk valley, a variance from Arctic to Upper Austral flora.

The chief factor producing this seemingly "opposite" development in view of rainfall and growth is the delimiting combined effect of altitude, decrease of temperature and shortening of growing period. In the higher Adirondacks where the average yearly rainfall exceeds fifty inches and the annual temperature mean is under thirty-five degrees, it must be noted that by far the larger amount of the percipitation will be in the form of snow, which melted still cold, adds little to growth processes and to a large extent quickly runs off the more precipitous terrain. (It must also be noted that

per year in New York. We find a variance of over twenty inches of rainfall within the state. We charrye a similar distribution of rainfall and floral conditions, but we notice the modification by other factors. It is not enough to may that in a given area the more the rainfall (within optimum limits) the greater will be the vequetation. The very factors that to a large extent are responsible for an increased rainfall else serve to delimit the type of floral climax. In the southern part of the state much more uniformity of rainfall extent then uniformity of vegotational climax. In a transact extent the Catakilla to long Island, a distance of one hundred miles, we find all the variance between climax of the Canadian ditions exist over a transact of the hundred miles from the formation to the florax of the hundred miles from the florax for the florax valley, a variance flows the to Upper austral flora.

The chief factor producing this seemingly "opposite" development in view of rainfall and growth is the delimiting occapined effect of altitude, decrease of temperature and shortening of growing period. In the bigher Adirondacks where the average yearly rainfall exceeds fifty inches and the entered temporature mean is under thirty-five degrees, it must be noted that by far the larger amount of the papelphtetion will be in the form of snow, which melted atill cold, edds will be in the form of snow, which melted atill cold, edds off the for growth processes and to a large extent quickly runs off the more precipitous terrain. (It must also be noted that



it is possible for the soil to incorporate a larger amount of water in these regions and hold it till the warmer climatic conditions allow abundant growth.) Although abundant, the growth in these regions is thus naturally limited to the hardier northern species by colder soil water condition colder atmospheric temperature and shorter growing period, factors which in part cause each other or are "cocausal".

The effect of large bodies of water is also conspicuous. The east-west position of Lakes Erie and Ontario moderates the climate and as a result extends the Upper Austral zone from the Buffalo-Niagara region east to the Oneida Lake Basin.

In constrast, Lake Michigan passes through three floral zones, its nor th-south position having much less effect on the climate. It should be noted, moreover, that the Austral zone extends farther north on the east side of the lake where the prevailing winds are off the water and hence the temperature is moderated. (U.S.D.A.<sup>3</sup>) The effect of the lakes (Figure 14) is further seen in the southward extension of the warmer zone flora along the shores of the Finger Lakes and the shores of Lake Champlain and Lake George. It is true that we have here in addition to the effect of the lakes the effect of lower altitude.

The effects of the large bodies of water are various.

They tend to equalize and stabilize temperature. They warm

to a greater depth and hold heat longer than land. Evaporation

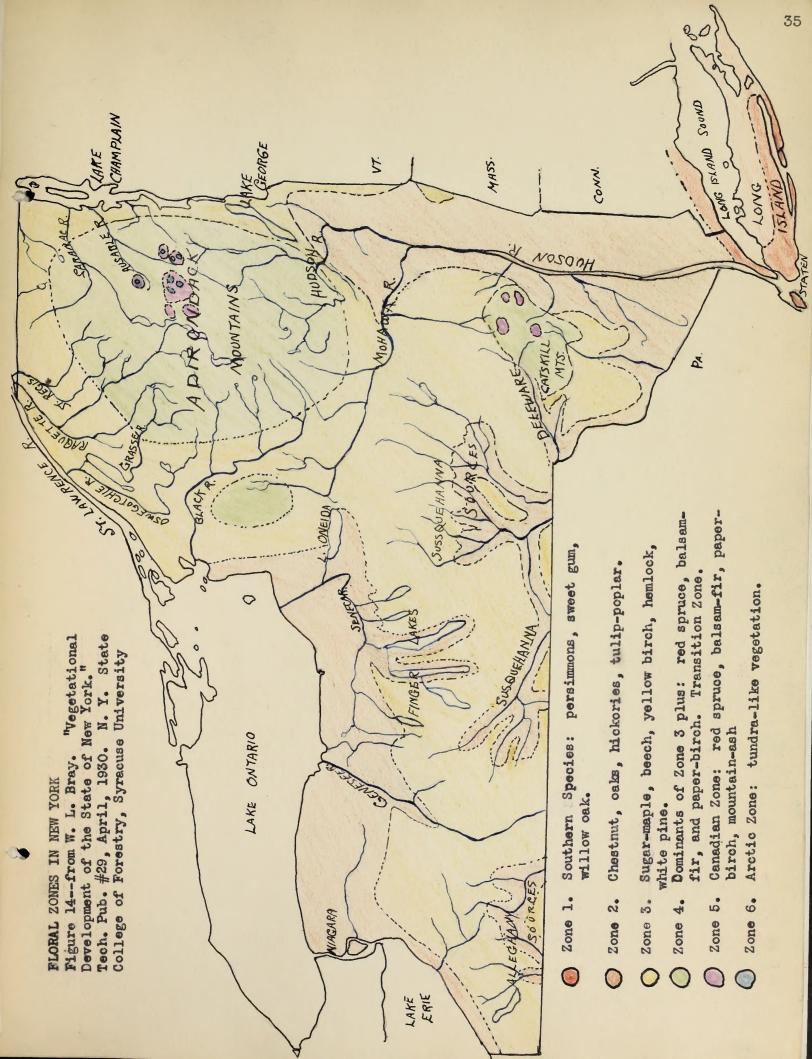
develops a moist blanket of air above and adjacent to the

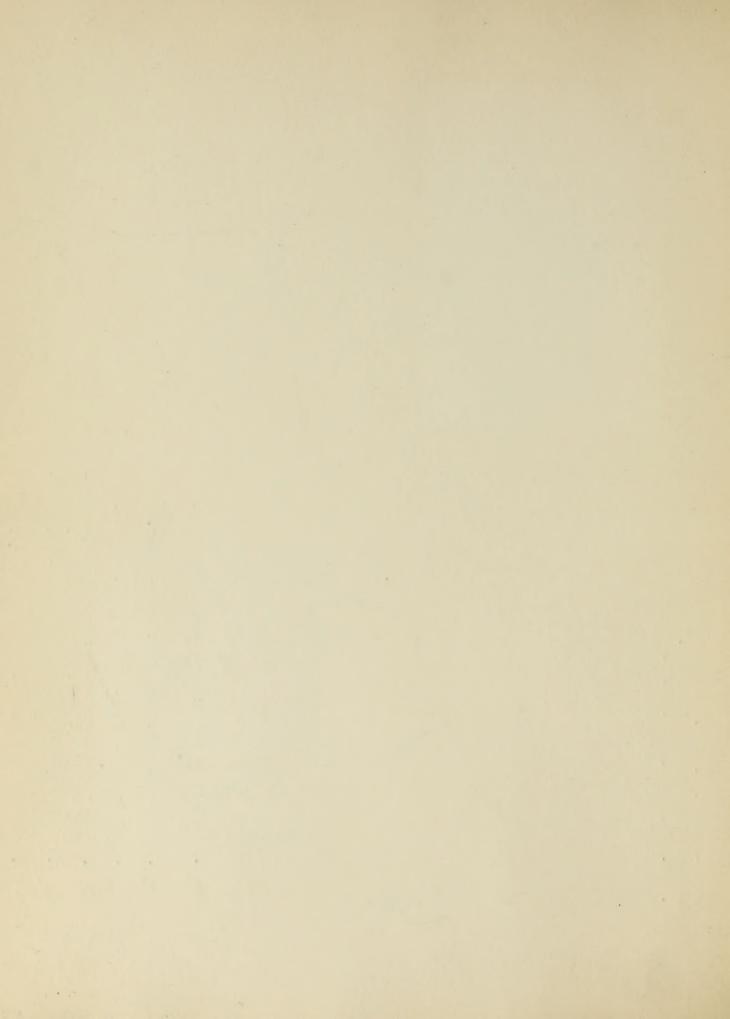
It is possible for the soil to incorporate a larger emount of water in these regions and hold it till the warmer climatic conditions allow abundant growth.) Although abundant, the growth in these regions is thus naturally limited to the hardier northern apecies by colder soil water condition colder standard to temperature and chorter growing period, factors which in part cause each other or are "cocausal".

The effect of large bodies of water is also conspicuous. The east-west position of lakes Erie and Obterio moderates that climate and as a result extends the Upper Austrel cone from the Buffslo-Miagars region east to the Chaida Lake Basin.

In constrast, less Michigan passes through three floral cones, its nor the south position baving much less effect on the climate. It should be noted, moreover, that the Austral cone extends farther north on the east side of the lake where the prevailing winds are off the water and hence the temperature gravalling winds are off the water and hence the lakes (Figure 14) is further seen in the southward extension of the warmer of lake Champlain and lake George. It is true that we have here in addition to the sleet of the lakes the effect of here is a addition to the effect of the lakes the effect of here is addition to the effect of the lakes the effect of here is addition to the effect of the lakes the effect of

The effects of the large codies of water are various.
They tend to equalize and stabilize temperature. They were
to a greater depth and hold nest longer than land. Evaporation
develops a moist blanket of air above and adjacont to the





water surfaces. This blanket of air is less affected (or affected more slowly) by temperature fluctuations than dry air is affected. This makes the winters warmer, the summers cooler, the springs later and the autumns later.

Soil conditions vary in the mesophytic climax according to whether the beginning was mesophytic, xerophytic, or hydrophytic in tendency. The first of these conditions would be in the form of a fairly thick layer of soil to which humus additions would bring much organic improvement. The bed in this case would vary according to the type of rock and mineral decomposed in forming the original soil. There is no doubt this type of soil would produce the greatest and most varied flora. Much of the farming area is on this kind of terrain. Clearing has left only scattered remnants in the form of the prized "wood-lot", but even these have usually been lumbered and are now "gardened" or "landscaped" by selection of species (as in sugar woods) and removal of dead wood before the process of decomposition has set in so that the natural sequence is broken. Cattle also often destroy many features of the ground cover in these "lots". Soil in the second of these varies greatly. As in Figure 15, vegetable remains plus very little decomposed rock often make up the only soil cover on a glacial xerophytic terrain. (Here the mesophytic climax has become a white pine, white spruce and maple society, although the photo shows a sub-climax of various birches, maples and young conifers gaining a foothold in the

water surfaces. This blunket of air is less affected (or affected more slowly) by temperature fluctuations than dry air is affected. This makes the winters warmer, the surface later and the autumna later.

at bed ent . Juenevouget ofgapro down paire bloom anoitibbe decomposed in forming the original soil. There is no doubt . nimited to boil elist no el ment poleral eds lo mont . eroll quence is broken. Cattle sico often deatroy rany leatures of these veries treatly. As in Figure 15, vereteols remain: nius



underbrush. The photo was taken in Essex County, New York. Figure 16 shows the ground or soil conditions prevailing at 3,300 feet on Whiteface Mountain, with a stand of typical Canadian-Transition zone flora, a spruce, balsam-fir, paper-birch society. Here the roots are very shallow and the bed stained by the leaching of humus organic matter.

Figure 15 Figure 9 illustrates the soil con-

ditions of the third type of soil terrian. The rate of humus accumulation varies with the general acidity of the soil, the

tendency being the more acid the soil, the more slowly plant growth and consequently humus formation takes place.

Finally the characteristics of climax mesophytic forest can be summarized as in the following outline from Bray's discussion of factors of growth. I. Soil.

> 1. It is well-drained and well-ariated.



Figure 16

andergrands. The paper on a being ann-lin, paper-birok sculety.

Pigure & illustrates the sound ditions of the third type of localen. Ine rate of interest secundation varies with the canona soldity of the sold. The

snale glwola orom ond . Lice formation takes place.

engalon of factors of growth. . Ilos . I

and well-aristed.

- 2. It is populated by many inter-dependent living organisms of both live roots and living bacteria
  which help change decaying organic matter to a
  usable form of soluble nitrogen.
- Soil is mechanically changed by great roots piercing it.
- 4. It is rich in available soil nutrients.

#### II. Growth Forms:

- 1. Deciduous trees of broad-leaved plants.
- 2. Conifers of needle-shaped leaves.
- 3. Evergreens of broad leaves.
- 4. Shrub types.
- 5. Climbing vines.
- 6. Perennial rootstocks -- small woody plants.
- 7. Monocotyledonous and dicotyledonous annuals.
- 8. The bulk of spring flowers in forms of: bulbs, corms, rhizomes, rootstocks.
- 9. Ferns, club-mosses.

#### III. Growth relations:

- 1. Differentiated light conditions of high forest foliage.
  - 2. Atmospheric conditions (heat, cold, air movement, reduced evaporation from floor of forest, rainfall).
  - 3. Distribution of roots in forest society.
    - 4. Saprophytic and symbiosic bacterial action.
  - 5. Mycorhiza (on beech, birch, pine, and hemlock).

- ganiams of both live roots and living bacteria
  which help change decaying organic matter to a
  usable form of soluble nitrogen.
- 3. Boil is mechanically changed by great roots piercing
  - . It is rich in available soil nutrionto.

# II. Growth Forms:

- as due trade of great leaved plants.
  - 2. Confiders of needle-shaped leaves.
    - 3. Evergreens of broad leaves.
      - 4. Shrub types.
      - 5. Climbing vines.
- S. Perennial rootstocks -- amall woody plants.
- 7. Monocotyledonous and dicotyledonous annuals.
- 8. The bulk of apring flowers in forms of: bulbs, corms, rhisomes, roobsbocks.
  - 9. Perma, club-mosses.

# iii. Growth relations:

- i. Differentiated light conditions of migh forest
- 2. Atmospheric conditions (nest, cold, air movement, reduced everoration from floor of forest, reinfall).
  - . Distribution of roots in forest acciety.
  - 4. Saprophytic and symplosic becterial action.
  - 5. Mycormizz (on beech, birch, sine, and nowlock).

- 6. The combination of factors that maintains equilibrium or stability of the climax bringing on the stabilizing of the soil conditions.
- B. The Floral Zones of New York as Mesophytic Climax

  Merriam<sup>9</sup> would place New York as a state in a Transition zone the overlapping of a southerly group of oaks and chestnuts with a more northerly group of birches, beeches, sugar maple, and hemlock. Thus considered, New York State would not include the Canadian-Transition or true Canadian boreal zone.

It is true that the state as a whole does seem to possess floral contrasts. There is in various parts well-developed boreal vegetation indicated by balsam-fir, red spruce, and paper birch, a climax which reaches its greatest development in Canada much farther north. On the other hand, we find clearly defined regions of the great south Appalachian hardwood vegetation, known as the Austral zone, reaching its greatest development southward and southwestward through Tennessee, Arkansas, and eastern Texas. New York becomes a meeting ground or truly a transitional stage. This transitional region is composed of the familiar types of maple, beech, yellow birch, hemlock and white pine forest. "It may be said to reach its maximum development in the New York type environment." (Bray2) Looking for an accounting for this occurrence, we easily see how the Appalachian axis forms an highway for these northern forms to dip south past their

- odd no galgaind xaillo odd to gallicax bringing on the stabiliting of the colditions.
- H. The Floral Zones of New York as Masophytic Climax

  Merrian would place New York as a state in a Transition zone the overlapping of a southerly group of cake and
  chestauts with a more northerly group of birches, beeches,
  sugar maple, and hemlock. Thus considered, New York State
  would not include the Canadian-Transition or true Canadian
  boresl zone.

sees flore contracts. There is in vertous parch well-dayesorge ber . Til-masiad vd besesbol noisetes ve serod Begola and paper, pirch, a client which rescoes its greatest development in Canada much fartner north. On the other hand, we hardwood vegetation, known as the Austral zone, reaching Tennessee, Ar massa, and eastern Texas. New York occomes besen, yallow bires, herdicak and white ping forest. "It this occurrence, we easily see how the Appalachian axis forms

normal coast latitude. Also we note the Atlantic coastal plain, warmed by the effect of the Gulf Stream to a temperature beyond the normal for its latitude, form s an high-way for the northward extension of more southern forms as: short-leaf pine, sweet gum, chestnut, willow oak, oak, persimmon, and others, some of them extending through New England as far as Maine. (The northern type of flora dipping southward along the Appalachian axis has a broader distribution of northern forms in the White Mountains of New Hampshire than it does in New York.)

Of the actual species of the flora of New York John Torrey 10 describes 1,450 species, of which 1,200 are herbaceous (150 ornamental). 250 woody plants (eighty with stature of trees). By 1924, House 11 describes 3,904 species. of which eighty-nine are pteridophytes, twenty-three are gymnosperms, 811 are monocotyledonous and 1,981 are dicotyledonous. House's number had more than doubled that of Torrey. This feature is easily accounted for by the amount of collecting that had been done for the State herbarium from 1840 to 1920, roughly sixty years. House's number will have additions by the next time an attempt is made to present the complete flora of New York. Torrey gives some proportions of outstanding families of plants that are still as true as when noted by him. The most numerous of the dicotyledonous plants are: Ranunculaceae (1/38 of total number), Scrophulariaceae (1/39), Umbelliferae (1/59).

normal opest latitude. Also we note the Atlantic coastel
plain, warmed by the effect of the Gulf Stream to a tempersture beyond the normal for its latitude, form a an highway for the northward extension of more southern forms ast
short-less pine, sweet gum, chestunt, willow cak, oak, persincen, and others, some of them extending through New
Angland as far as Maine. (The northern type of flore dipging southward along the Appalachian exis has a oreador
distribution of northern forms in the White Mountains of
New Hampahire than it does in New York.)

Torres describes I. 480 species, of which I, 400 are herbecome (150 ornamental), 250 woody plants (elints with stature of trees). By 1984, House I describes 5,904 species, sent the complete flore of New York. Torroy rives some add to sucremun doos shir . min yd bedon medw as arri an number). Scropbylariscens (1/39), Umbelliferse (1/59),

Cruciferae (1/45), Leguminosae (1/26), Rosaceae (1/25), Compositae (1/9), Ericaceae (1/34), Labiatae (1/32); of the Monocots: Orchidaceae (1/39), Cyperaceae (1/9), Gramineae (1/12). These few families alone constitue nearly 60% of the total flora. Of these few alone Cyperaceae, Gramineae and Compositae equal 30% of the group. These proportions will vary but little from the average for the whole flora of North America.

Following is a listing of the floral zones of New York State and their indicator species presented by Bray<sup>2</sup>. The scientific names cited have been corrected to comply with the nomenclature of Gray's Manual.

FLORAL ZONES OF NEW YORK STATE AND THEIR INDICATOR SPECIES

1. Zone of Willow Oak, Sweet Gum, Persimmon, etc.

Indicator Species: Short-leaf pine

Pinus echinata Mill.

Willow oak

Quercus phellos L.

Black oak

Quercus velutina Lam.

Black-jack oak

Quercus marilandica Muench

Laurel magnolia

Magnolia virginiana L.

Sweet gum

Liquidambar Styraciflua L.

Hop-tree

Ptelea trifoliata L.

Mistletoe

Phoradendron flavescens (Pursh) Nutt.

Virginia Spiderwort

Tradescantia virginiana L.

Day flower

Commelina virginica L.

Cruciferse (1/45), Leguminosse (1/26), Rosacese (1/25), Compositae (1/9), Ericacese (1/34), Labistae (1/52); of the
Monocots: Orchidacese (1/35), Cyperacese (1/3), Graminese
(1/12). These few families alone constitue nearly 60% of
the tosal flore. Of these few alone Cyperacese, Graminese and
Compositae equal 30% of the group. Those proportions will
very but little from the overage or the whole flore of North
America.

Following is a listing of the floral zones of New York state and their indicator species presented by Bray? The scientific names cited have been corrected to comply with, the nomenclature of Gray's Manual.

PLORAL TORES OF NEW YERE STATE AND THILD INDICATOR SPINCIES

1. Zone of Willow Oak, Saset Gum, Persismon, oto.
Indicator Species:
Thort-lest bine
Pinus achieve Will.

wallow oak guerous phelics L.

Man som - some

Leurel market in molla virginisma L.

Sweet num Inquidemper Styreofflus I.

.l stalightet asist pert-qui

Mistleton Clavesco

.dun (nergi)

.I and all applianment tradescentia virginional.

Day flower Commelina virginice L.

Distribution: Staten Island, southern Long Island coastward, and a narrow strip along the Sound from Manhattan and the Brox to and along the Connecticut coast. There are about two hundred frost free days over this area. In addition to those named above the species of Zone 2 and some of Zone 3 are to be found in this area perhaps in even greater numbers than the indicators of Zone 1 itself.

2. Zone of Dominance of Oaks, Hickories, Chestnut, Tuliptree, etc.

### Indicator Species:

Red cedar

Black walnut

Butternut

Hickories

Bitternut or swamp hickory

Shag-bark or shell-bark

King-nut or big shag-bark

White-heart hickory, mocker-nut

Small-fruited hickory

Pignut hickory

Oaks

Red oak

Swamp or pin oak

Scarlet oak

Juniperus virginiana L.

Juglans nigra L.

Juglans cinerea L.

Carya cordiformis (Wang)
K. Koch

Carya ovata K. Koch

Carya laciniosa (Michx.f.)
Loud.

Carya alba (L.) K. Koch

Carya microcarpa Nutt.
Britton

Carya glabra (Mill.) Spach.

Quercus rubra L.

Quercus palustris Muench.

Quercus coccinea Muench.

Distribution: Statem Island, southern Long Island coattward, and a narrow strip along the Sound from Esnistian and
the Brox to and along the Connecticut coast. There are
about two hundred frost free days over this area. In sidition
to those named above the species of Zone 2 and some of Zone
3 are to be found in this area perhaps in even greater numours than the indicators of Ione 1 itself.

E. Esas of Dominance of Cairs, Hickories, Chestnut, Puliptree, etc.

# : seinegs Todantbal

Red nedar

Black walnut

Butternut

# Hickortes

Bitternut or swamp blokory

Sheg-berk or shell-berk

White-heart hickory,

Small-fruited blokery

Pienut hickory

#### Cakes

Red oak

away or plu osk

Juntosmus virginisas L.

Jugians nigra I.

Juglans cinerca L.

Marya cordiformia (Wang)

(.1.xdolM) asointosi agree)

Carya alpa (1.) K. Koch Carya microcarpa Nutt. Britton

Carrie glabre (Mill.) Spach.

querens rubra L.
quereus palustris Muench.
Quereus occulars Muench.

Black oak

Gray oak

White oak

Post or iron oak

Mossy-cup or burr oak

Swamp white oak

Rock chestnut oak

Chestnut or yellow oak

Others

Sweet birch

Chestnut

Hackberry

Red mulberry

Cucumber tree or Mountain

magnolia

Tulip-tree or yellow poplar

Papaw

Sassafras

Wild hydrangea

American crab-apple

Sycamore

Red-bud

Kentucky coffee-tree

Honey-locust

Quercus velutina Lam.

Quercus ellipsoidalis E. J.

Hill

Quercus alba L.

Quercus stellata Wang.

Quercus macrocarpa Michx.

Quercus bicolor Willd.

Quercus prinus L.

Quercus Muhlenbergii Engelm.

Betula lenta L.

Castanea dentata (Marsh)

Borkh.

Celtis occidentalis L.

Morus rubra L.

Magnolia acuminata L.

Liriodendron tulipfera L.

Asimina triloba Dunal

Sassafras variifolium

(Salisb.) Ktze.

Hydrangea arborescens L.

Pyrus coronaria (L.)

Platanus occidentalis L.

Cercis canadensis L.

Gymnocladus dioica (L.)

Koch.

Gleditsia triacanthos L.

Slack oak

Gray oas

White salo

Post or fron oak

Morey-cup or burr oak

Swamp white oak

Rock chestnut oak

Chestaut or yellow cake

Ohners

norte Jeewa

Chestant

Hackberry

Red malberr

Opposite tree or Mountain

Tullp-tree or yellow pupler

Papas

Sassafras

Wild hydranger

siqua-davo nacivemA

Зусадоге

Red-bud

Mentucky coffee-tree

Honey-Locust

guerous velutina Lum.

Quercus ellipsoidalis E. J.

Quercus alba L.

querous stallate warmeng.

Justons macrocarpa Michx.

Quercus sicolor Willd.

Quereus prinus L.

Quercus Munlenbergil Engelm.

Rebula Lenta L.

Castanes dentata (Marah)

Celtis occidentalis L.

Morus rubra L.

.I staniques allonged

Lirichandrum tmilpfare L.

Anima tellose Dunal

Sassafras variaceda

Lygranges erborescould I.

Fyrus coroneria (L.)

Platenus confidentells L.

Cercia camedensia I.

Gymnocladus diolos (L.)

Gladitain triscentings L.

Prickly-ash

Flowering dogwood

Tupelo

Great laurel

Mountain laurel

Xanthoxylum americanum Mill.

Cornus florida L.

Nyssa sylvatica Marsh.

Rhododendron maximum L.

Kalmia latifolia L.

Some of the small herbaceous species

White dog-tooth violet

Lizards tail

American Lotus or Water chinquapin

Golden-seal

Wild sensitive plant

Partridge-pea

Shooting-star

Virginia cowslip or bluebell

Erythronium albidum Nutt.

Saururus cernuus L.

Nelumbo lutea (Willd) Pers.

Hydrastis canadensis L.

Cassia nictitans L.

Cassia Chamaecrista L.

Dodecathion Meadia L.

Mertensia virginica (L.) DC.

There are found in addition to these certain other of the austral group of plants, e.g., Smilax, legumes, composites, certain grasses, which are represented rather strongly in this zone but disappear or are sparsely represented in Zone 3. This list could be very much lengthened, but the above list gives a fair representation of the zone.

Distribution of Zone 2: Upper part of Long Island and Staten Island; Hudson Valley region and adjacent highland valleys, becoming thinned out by the disappearance of many species (chestnut stopping below Lake Champlain, red oak, white oak, shell-bark hickory, red-cedar and some others extending on

des-visions

Flowering dogwood

ofenur

Great laurel

Mountain laurel

Rindedendron maximum L.

or printfil

Some of the small herbaceous anacles

White dog-tooth violet

Idea obteshi

American Lotus or Water

Golden-seal

traiq evidianes bitW

Partridge-pas

Shootlag-ster

virginia cowallo or

Erytonomium sloidem Nutt.

Samming commus L.

Cornus florida L.

Myssa sylvatios Marsh.

Nelumbe lutes (Willd) Pors.

Hydrastle canadensia b.

Cassia nichitana L.

Cassia Chamacorista L.

Jodenathico Pendin L.

.DG (.I) solutativ stemstand

There are found in addition to these certain other of the squared group of plants, c. g., Smilax, legumes, composites, certain gresses, which are represented rather strongly in this some but disappear on are sparsely represented in some 3. This list could be very much langthened, but the spove list gives a fair representation of the some.

Distribution of Tone 2: Upper part of Long Island and Statem legand; Hudson Valley region and adjacent highland valleys, becoming thinned out by the disappearance of many apecies (chestaut stopping below Lake Champlain, red cak, white cak, shell-bank hickory, red-cader and some others extending on

up to the St. Lawrence); the Delaware, Susquehanna, and Alleghany drainage valleys; the Finger Lake valleys; the Mohawk Valley especially on southern exposure; the narrow Erie belt and the broader Ontario-Iroquois basin (chestnut very notable on sandy soils) to the Oneida Lake basin; and northward thinning out by the disappearance of chestnut, tulip-tree, certain oaks and hickories toward the St. Lawrence valley. Also low elevations to twelve hundred feet more or less and in territory under the influence of the maritime and the lakes.

The frost-free period in this area is about one hundred sixty to one hundred seventy days. Where "thinned out" conditions of the zone occur the period is only one hundred fifty days.

3. Zone of Dominance of Sugar Maple, Beech, Yellow Birch, Hemlock, and White Pine Mixed Forest. Alleghany-Transition Zone.

# Indicator Species:

White pine

Hemlock

Hop hornbean

Blue or Water beech

Yellow birch

Witch hazel

Juneberry

Pinus Strobus L.

Tsuga canadensis (L.) Carr.

Ostrya virginiana (Mill.)
K. Koch

Carpinus caroliniana Walt.

Betula lutea Michx. f.

Hamamelis virginiana L.

Amelanchier canadensis (L.)
Medic.

up to the St. Lawrence); the Delaware, Susquebanya, and Alleghany drainage valleys; the Finger Lake valleys; the Mohawk Valley especially on southern exposure; the narrow Srie belt and the broader Ontario-Iroquota basin (chestnut very notable on sendy soils) to the Oneida Lake basin; and northward thinning out by the disappearance of chestnut, tulip-tree, certain cake and nickories toward the St. Lawrence valley. Also low elevations to twelve hundred feet nore or less and in territory under the influence of the maritime and the lakes.

The frost-free period is this area is about one inn-dred sixty to one nundred seventy days. Mere "thinned out" conditions of the some occur the eriod is only one hundred fifty days.

3. Zone of Dominance of Sugar Maple, Beach, Yellow Sirch, Memicok, and White Pine Mixed Porest. Alleghang-Tran-

# Indicator Species:

enig edidw

Herricck

Red mombes

Blue or Water been

deale welley

Ioned dod N.

Jugeboring

Pinus Strobus L.

Proga considencia (L.) Carr.

Ostrya virginiana (Mill.)

Carpings carellaran Walt.

Botola luten Michx. f.

Memmisla virginiana L.

Amelanchier canadensis (L.)

Wild black cherry

Sugar maple

Red maple

Striped maple

Mountain maple

Basswood

White ash

Prunus serotina Ehrh

Acer saccharum Marsh.

Acer rubrum L. Notably in swamps

Acer pennsylvanicum (common

also in Zone 4)

Acer spicatum Lam.
Tilia americana L.

Fraxinus americana L.

Also in this zone is found about the maximum growth of the forest floor herbaceous growth-forms which comprise generally the popularly favorite spring woodland flora of the eastern half of the continent. It appears they are rendered less susceptible to the cold winters and climatical extremes on account of their close relation to the deep-warm soil blanket of climax forests. Some of these species referred to above are: Virginia grape fern, hay scented fern, christmas fern, evergreenwood fern, maiden hair fern, plantain-leaved sedge, jack-in-the-pulpit, wild leek, yellow adder's tongue, false spikenard, bell-worts, solomon's seal, indian cucumber, large-flowered trillium, showy orchis, wild ginger, carolina spring beauty, red baneberry, white baneberry, wild columbine. tall anemone, hepatica, tufted buttercup, early meadow rue, blue cohosh, twinleaf may apple, blood root, dutchman's breeches squirrel corn, pepper root, two-leaved toothwort, bishop's cap, barren strawberry, downy yellow violet, striped violet, long spurred violet, american spikenard, ginseng, ground-nut.

Wild black charry Sugar maple Hed maple

striped maple

Hountain maple

Acer asconarum Larah.
Acer asconarum Larah.
Acen reprum I. Notably in

Acer pennsylvanicum (common also in Zone 4)

acer spicetum Lam.

Frexions smartcana I.

glum cohoga, twiniess cay apple, plood ront, dutermen's bresche, barren etraweerry, downy yellow violet, chrisen violet, long Distribution in New York: There is a tendency for this group to occur upon every edaphic situation throughout the state up to two thousand feet (in the Catskills) excepting in general the Adirondacks, but dominant over the Alleghany plateau region and the Catskills below the spruce-balsam line.

The number of frost-free days where this flora is found is about one hundred thirty to one hundred fifty.

The zone is more or less arbitrarily distinguished from the maple, beech, birch, hemlock, of the Adirondacks and Catskills which contain and are often dominated by red spruce, balsam, white birch, etc., on the one hand and presence of some species of Zone 2 which are lacking in the Adirondacks.

4. Canadian-Transition Zone:

This zone has as dominants maple, beech, yellow birch and white pine as in Zone 3, but in addition (and with a tendency to dominate in special situations, higher altitudes in particular) red spruce, balsam, paper birch, mountain ash, etc. It is further characterized by a conspicuous decreasing of forest floor herbaceous growth-forms of the Appalachian region generally, and the more frequent appearance of more northerly species.

### Dominant Trees:

Red spruce

Black spruce

Picea rubra (DuRoi) Dietr.
Picea mariana (Mill.)
BSP.

eniseroot, awast closic, indian pipe, and coach drope.

Distribution in lew York: There is a tendency for this group
to occur upon every adaphic situation throughout the state

of two thousend feet (in the Catakilla) excepting in general

The number of frost-free days where this flore is found is should be about one numbered tality.

The maple, beach, biren, hemiocs, of the Adirondecks and the maple, beach, biren, hemiocs, of the Adirondecks and Casavilla which contain and are often dowinsted by red apruce, of the one hand and present of some access of your 2 which are lacether in the Adirondecks.

A. Canadian-Transliton Zone:

rents tone has as idealpants maple, seems, yellow birds and white pinessa in Ione 3, out in addition (and white a pinessa in Ione 3, out in addition (and white a bendency to dominate in trends alternations, higher altitudes in particular) red apruce, calses, paper niroh, mondain and, etc. It is further characterist of a conspicuous decreasing of forces floor herbaceous growth-forms of the Ampeleous acres and the more fractions as appearance of more northerly apeales.

Dominant Trong

Red sprace

sla of spruce

Place ration (Mail.)

Balsam fir

Abies balsamea (L.) Mill.

Mountain ash

Pyrus americana (Marsh.) DC.

# Forest Floor Species of Special Note:

The following not only occur generally distributed throughout the Adirondacks and highest Catskills, but each may occur in large stretches as an exclusive formation.

Shield fern

Aspidium spinulosum var. inter-

medium (Muhl.) DC. Eaton

Hobble bush

Viburnum alnifolium Marsh.

Shining club-moss

Lycopodium lucidulum Michx.

True wood-sorrel

Oxalis Acetosella L.

Ground hemlock

Taxus canadensis Marsh.

Others of this zone but occurring in 3:

Red-berried elder

Sambucus racemosa L.

Bush honesuckle

Diervilla Lonicera Mill.

Wild sarsaparilla

Aralia nudicaulis L.

Fetid currant

Ribes prostratum L'Her.

Large-leaved golden-rod

Solidago macrophylla Pursh.

Mountain aster

Aster acuminatus Michx.

The following becomes more conspicuous in the Adirondacks largely because of the absence of the forms above cited:

Bunchberry

Cornus canadensis L.

Yellow clintonia

Clintonia borealis (Ait.)

Raf.

Twin flower

Linnaea borealis L., var ameri-

cana (Forbes) Rehder.

Two-leaved Solomon's seal

Maianthemum canadense Desf.

Stiff club moss

Lycopodium annotium L.

Balaam fir

rise niedmrold

Abies Deleamos (L.) Mill. Fyrus emericana (March.) DG.

Започена споможа Б.

Forest Floor Species of Special Notes

The following not and process of the following the Adirondecks and algoss Optaxills, out each

Saleld ferm Application apinulosum ver. intermedium (Noal.) DC. Katon

House bush mulicilus alumnostv resultation mare

Shining club-moss . Igoogodium lucidulum Michx.

True wood-sorrel Capits Acetosella L.

Pround hemlock Ta us consideral March.

Others of this cone out coquering in 3:

the contract of the second sec

Sush honesuckle Dierville Lonicere Mil.

.I elimoibun ailera allirenerse bliw

Feild current Rices prostratum L'Hen.

Large-leaved golden-rod borldage meerophylla Puram.

Mountain aster Accordantius Michael

The following becomes more conspicuous in the Adirondacks largely secause of the access of the secause of the s

mchosrry Cornes canadensis L.

Yellow olintonia Climbonia cornelis (Alt.

Twin flower av. . Linness boreslis L., ver smerlcann (sorbes) Robder.

Two-leaved Solomon's seal Malantinemum canadense Desf.

I muldonna mulbogoogi seem dulo 11138

Gold thread

Coptis trifolia (L.) Salisb.

One-flowered pyrola

Moneses unifolia (L.) A. Gray

### Distribution in New York:

In the Catskills from about two hundred feet to thirty-seven hundred feet (above which Canadian Zone forest is indicated by dropping out of maples, beech, hemlock, and pine) and in the Adirondacks generally as climax forest up to thirty-five hundred feet. Growing season one hundred to one hundred thirty days.

5. Canadian Zone. Dominance of Red Spruce, Balsam, and Paper Birch.

### Indicator Species:

Red spruce

White spruce

Black spruce

Balsam fir

Paper birch

Mountain ash

Fetid currant

Bunchberry

Twin flower

Creeping snowberry

Gold thread

Yellow Clintonia

Stiff club moss

Picea rubra (DuRoi) Dietr.

Picea candensis (Mill.) BSP.

Picea mariana (Mill.) BSP.

Abies balsamea (L.) Mill.

Betula alba L. var papyrifera (Marsh) Spach.

Pyrus americana (Marsh.) DC.

Ribes prostratum L'Her.

Cornus candensis L.

Linnaea borealis L., var. americana (Forbes) Rehder.

Chiogenes hispidula (L.) T. & G.

Coptis trifolia (L.) Salib.

Clintonia borealis (Ait.) Raf.

Lycopodium annotinum L.

delise (1.1) alloting sligo.

Monoses unifolis (L.) A. Gray

# One-Ilowared pyrols

In the Catakills from about two bundred feet to thirtyseven numbred feet (above which Canadian Zone forest is indicated by dropping out of maples, bedom, hemicok, and pine)
and in the Adirondecks generally as climax forest up to
thirty-five hundred feet. Growing sesson one mundred to
one hundred thirty days.

E. Canadian Jone. Dominance of Red Spruce, Balean, and

## Indicator Species:

Hed aprice
White aprice
Black aprice
Belsem fir

Nowntein and Fetid current Bunchberry Twin flower

Creeping snowberry

Dold thread

Yellow Clintonia

Etill club moss

Hees repre (Duket) Dietr.

Pices candensis (1111.) BaP.

Steen mariana (Mill.) 859.

. LIM (. I) semester neigh

Setule alba I. var papyriform (Waran) Spuon.

Prus speriosos (Marsu.) DC.

Rices prostratus L'Har.

Corrana candonsis L.

Linemes berealts L., var. smericens (Forbed Render.

Chicgones hispidula (L.) T. 2 0.

.olio. (.1) elicited sideos

Olimbonia horsoila (Alt.) dar.

Lecopolium manovinum L.

Large-leaved golden-rod

Solidago macrophylla Pursh.

Mountain aster

Aster acuminatus Michx.

Increase of boreal (or bog) heath shrubs

Increase in lichens

Increase in mosses

### Distribution:

Not exactly typical on summits of highest Catskills but indicated by dominance of red spruce and balsam, much somewhat gnarled topped yellow birch, and sparse paper birch and by forest floor species. In the Adirondacks, the zone of spruce, balsam, paper birch and mountain ash which succeeds maple, beech, birch, hemlock, and white pine above thirty-five hundred feet more or less, is here referred to the Canadian Zone which in its typical composition as described by Cooper is the Northeastern conifer forest par excellence.

6. Zone of Arctic Flora of Adirondack Peaks

## Indicator Species:

Fir club moss

Alpine holy-grass

Mountain spear-grass

Small-flowered wood-rush

Scirpus-like sedge

Highland rush

Bearberry willow

Glandular or scrub birch

Lycopodium Selago L.

Hierchloe alpina (Sw.)

R. & S.

Poa laxa Haenke

Luzula parviflora (Ehrh) Desv.

Carex scripoides Schkuhr.

Juncus trifidus L.

Salix Uva-ursi Pursh.

Betula glandulosa Michx.

Aster noundania Michx.

coeds maple, beach, birch, herlock, and white pine souve

S. Mond of Arctic Flore of Addrendeds Pasks

.I camilas muibogon I (.wi) unigla solnameld

Black crowberry

Diapensia

Lapland rose-bay

Moss-bush

Cutler's alpine golden rod

Low rattlesnake-root

Empetrum nigrum L.

Diapensia lapponica L.

Rhododendron lapponisum (L.) Wahl.

Cassiope hypnoides (L.) D.
Don.

Solidago Cutleri Fernald

Prenanthes Boottii (DC.)
Gray

## Occurrence in New York:

The Mount Marcy group above five thousand feet; on Mount McIntyre and to a less degree on Whiteface Mountain and other high peaks.

The foregoing list of floral zones and their indicator species are graphically illustrated in Figure 14. The allocation of these zones is general; for example, floral members of zone 2 are found farther up the Mohawk Valley than is indicated. The same is true in the Champlain Valley;



far up the valley of Lakes
George and Champlain
"thinned out" zone 2 persists. Figure 17 near
Ticonderoga shows a typical "stand" of hickories
which are regular indicators of zone 2. Figure
18 near the same area as

Figure 17

Black crowberty

Diapensi

Tad-seot hosigal

Mend-seoM

Contler's alpine golden rod
Low rattlebnake-root

Empeteum uigrum I.

Diapeneta lapponies L.

Ekododendren lapponiaum (L.)

Casslope argneides (L.) D. Don.

Solidago Cutleri Fernald Premantmes Boottil (DC.) Gray

Occurrance in May Works

The Mount Marcy group above five thousand feet; on Mount and street Mointyre and to a leas of Whitefeet Mountain and other high peaks.

The foregoing light of flored some and trair indicator off -olds out . Placed in Figure 14. The allow serious the colored some carlon of these some is comed to the some of some in found forther up the Malawa Velley than led indicated. The same is true in the Charpinia Velley:

Theore and Champlala
"timing one" cone 2 per"timing out" cone 2 peralses. Figure 17 near
Thousers a cone 2 percal "shad" of alckorive
cal "shad" of alckorive
thing are recular indiastern of cone 2. Figure
22 near the same are as

TI summe 17



Figure 18

Figure 18 shows

typical oak, rock

maple, and hickories

with fairly sizable

chestnut saplings

which have grown

up since the chest
nut blight destroyed

the larger trees.

In a similar way typical growth of the zone 3 prevails farther up the rivers rising in zone 4 of the Adirondack region as illustrated by Figure 19, a photo taken near the source of the Saranac River. The "over-

lapping" of typical zones by modified conditions such as a broad river valley with close-by mountain heights thus makes possible a greater floral variety in the climax than in an area of zone 2, for example. The method of zone identification may be more fittingly applicable in general to a larger area but its lines of demarcation are definite in regions of rapidly increasing altitude as indicated by Figure 20. The ridges above



Figure 19

Figure 15 shows

by the large and bloweries

with fairly slable

chestnut saplings

which have grown

up since the chest
the large trees.

OI ogunia

In a similar way typical growth of the sone 3 provails

Parther up the rivers rising in sone 1 of the Adirondsok region sa illustrated by Figure 18, a photo basen near the source
of the Saranac River. The "overlapping" of typical sones by modified conditions such as a broad
fiver valloy with close-by mountain

neignes thus makes possiols a great
an floral variety in the climax
than in an area of some 2, for
easaple. The method of rone identification may be more fittingly
applicable in seneral to a larger
area but its lines of demarcallor
increasing altitude as indicated
by Figure 20. The ridges above

BI amn 14

"timber-line on the rocky-ledges support tundra-like vegetation of the Arctic zone 6. On a nearby mountain, Mount Marcy, Harshberger describes the "Krumm holz" or dwarf timber cover of approximately 5,000 feet in altitude. He notes: Abies balsamea (not over five feet in height) with Linnaea americana,



Figure 20

A - Arctic zone flora, B - Boreal or typical Canadian zone flora, C. T. - Canadian-Transition.

Chiogenes hispidula and Cornus canadensis beneath, while Vaccinium canadense and Pyrus americana are prominent shrubs.

The Arctic Zone in New York State is confined to the tops of Mount Marcy, the Gothics, Mount McIntyre, Whiteface Mountain and in very limited amounts to a few others of the highest points. Figure 21 shows a typical ground cover of tundralike vegetation of zone 6 as found on the mountains mentioned.

"timber-line on the rocky-ledges support tundra-like vegetation of the Arctic sone 6. On a nearby mountain, Mount Marcy, identified sone 6. On a nearby mountain, Mount Marcy, identified the "ifrum hole" or dwarf timber cover of approximately 5,000 feet in altitude. He notes: Abies balasmen (not over five feet in height) with Linnage americane.

OS enumits

Canadlan zone flora, C. T. - Canadlan-Transition.

Vaccinium considence and Fyrus americans are prominent shops.

The Arctic Jone in Now York State is confident to the tops of Mount Marcy, the Counts, Mount McIntyre, Whitespace Louisian and is very limited amounts to a few cinsis of the highest points. Figure 21 ands a typical ground gover of tender.

Jike vegetation of some 6 as lound on the mountains mentioned.



Figure 21, Whiteface Mt.

Figure 22 shows
more nearly typical mountain-top
plateau growth of
the type of zone 5
or the boreal or
Canadian zone;
photo taken on
Whiteface range

looking northeast. It is interesting to note that this type of growth extends downward to much lower altitudes on the northern slopes of mountains than it does on southern exposures, the transitional type of vegetation reaching to higher elevations under more favored temperature and light conditions.

The boreal zone growth seems to reach its optimum between 3500 and 5000 feet on higher mountains and on mountains under 4000 feet scarcely appears except when bog-like conditions

prevail, owing to abundant moisture supply. Peck<sup>13</sup> considers the black spruce an indicator of boreal conditions and considers the appearance of siz-able "stands" of



Figure 22

Figure CD shows

more nearly typical mountain-top
platesu growth of
the type of rone 5
or the bondal or
Canedian sone;
photo taken on

Figure 21, Walterage Mt.

looking northeast. It is interesting to note that this type of growth extends downward to much lower altitudes on the the continers alopes of weathern the translations of according to the translational type of vegetation resolding to digner clove-tions and a light conditions. The conditions from the conditions to reach the conditions and the conditions to the conditions and so conditions and an countries and the conditions and the conditions

prevail, owing to
abundant noisvure
supply. Feering
considers the class
apruce an indicator
of tores! conditions
and considers the
appearance of pic-

SS even15

them in various points outside of the typical boreal zone, as in Rennsselaer County, due to bog-like conditions which is almost the same as to say boreal conditions.

The appearance of these more northern vegetational climaxes or societies does not minimize the fact that the typical original climax of the state was mesophytic, of the type of growth as found in zone 3, white pine being the only evergreen found generally over the state with hemlock frequently in the society. Another evergreen, arbor vitae, is peculiar because of its appearance under vastly varying conditions ranging from near-zerophytic and scattered over the domain of zone 3. Almost pure stands are often found on almost pure sand. Again, it may appear on bog-like or swamp-like terrain in the same peculiar pure stands. It is also often found occupying very rugged rocky ledges. As already mentioned, typical zones 1, 2, and 3 have been greatly altered by city development and agriculture.

them is verious points out-side of the typical bores! conditions which is almost the same as to say bores! conditions.

The appearance of these more northern vertational oilmases or societies does not minimise the fact that the typical
original climax of the state was mesophytic, of the type of
grawth as found in note 3, white pine being the only everymen
found generally over the state with heribock frequently in the
society. Another everyment, aroor vitae, is peculiar termine
of its appearance under vestly verying conditions randing
from near-xerophytic and nonttered over the domain of some 5.
Almost pure stands are citen found on almost cure sand. Acain,
it may appear on bos-like or samp-like termin to the sand
runged rows ledge. It is also often found security very
it, and 3 have been greatly altered by othy development and
arriculture.

#### V. Summary

Drawing together the various phases of the subject dealt with in the above pages, the writer draws the following conclusions:

- 1. That the floral background of the State of New York, developing from the viscissitudes of geological change has had a profound influence upon the present floral conditions. The effect of any period of gigantic ice coverings would be enough to destroy local vegetation, and a species as well, if it could not retreat to a position where it could survive. The consequent tearing and defacing of the terrain and the melting of ice would produce the conditions of all three main types; xerophytic, hydrophytic, and mesophytic, so that vegetation returning would have to work from conditions least favorable or less favorable to conditions more favorable, in a manner necessarily quite similar to the process by which vegetation would now occupy a recently available terrain or condition for plant invasion or re-occupation.
- 2. That the State of New York is typically mesophytic in its floral climaxes. Within the general area of the state are occasional excepted areas tending more toward xerophytic or hydrophytic conditions, but the factors at work in even these excepted areas are producing typical mesophytic conditions as rapidly as consistent vegetational development produces them from the particular type of condition prevailing beforehand.

#### V. Summery

Drawing together the various phases of the subject dealt with in the above pages, the writer draws the following conclusions:

- I that the floral deciground of the State of New York, developing from the visqissitudes of geological change has had a profound influence upon the present floral conditions. The effect of any period of gigantic tee covarings would be enough to destroy local vegetation, and a species as well. If it could not retreat to a position where it could survive. The consequent tearing and defacing of the terrain and two maining of ice would produce the conditions of all three rain types; xerophytic, hydrophytic, and masquhytic, so that septention returning would have an more from conditions lead favorable or less favorable to conditions more favorable, which vegetation would now occupy a recently available termination of plant invasion or re-occupation.
- 2. That the State of New York is bypically mesophybic in its floral climanes. Within the general area of the state are occasional excepted areas tending more toward xerophytic or hydrophytic conditions, but the factors at work in even these excepted areas are producing typical mesophytic conditions as repidly as consistent vegetational development produces them from the particular type of condition preveiling beforehand.

- 3. That the State of New York is typically Transitional in its floral climax, but the modification by altitude and the effects of bodies of water (Great Lakes and Gulf Stream) causes the development of climax typical of more northern climax on the one hand and of more southern climax on the other.
- 4. That the natural vegetational climax has been very much interrupted permanently by agriculture and city development. The Austral type of flora of Staten Island, the Bronx, Richmond, and western Long Island has been all but removed by city development. Zones 2 and 3 have been much interrupted by farming. Zones 4 and 5 have been lumbered until the mountain regions are pillaged weed patches compared with what they were.
- 5. That it is expedient that all within the limits of man be done in favor of natural vegetational development in restoring as large areas as possible to their former capacities. In doing this it is important that true values be recognized in determination of what lands would be profitably kept for agricultural purposes. By wise selection of plant species for an unproductive area will usually result in the yielding of a valuable crop on that area. Figure 23 clearly shows the result of wise reforestation on sand-country near Saranac Lake. This type of work is being done

- In its florel climax, but the modification by sitibude and in its florel climax, but the modification by sitibude and (meets of bodies of water (Great Lakes and Gulf Stream) the effects of climax typical of more northern climax on the one band and of wore southern olimax on the one band and of wore southern olimax on the
- A. That the netural vegetational climax has been very mach interrupted permanently by agriculture and city development. The Austral type of flore of Staten Island, the Bronx, Richmond, and western Long Island has been all but removed by city development. Zones 2 and 3 have been much interrupted by ferming. Zones 4 and 5 have been much interrupted mountain rurions are pillaged weed patches compared with they were.
- of man be done in favor of natural veretational development in restoring as large areas as resaible to their former ospecities. In doing this it is important that true values to recognized in determination of what lands would be profitably kept for agricultural purposes. By wise selection of plant species for an unproductive area will usually result in the yielding of a valuable crop on that area. Figure 25 clearly shows the result of wise referentation on send-



Figure 23

increasingly over the state, often
by private citizenry. Wise
lumbering operations can be carried on to the end they produce
almost the same conditions as
reforestation and in some ways
conditions superior to reforestation.

6. That in spite of the effects of man natural recourse tends to vegetational "correction".
This is very easily observed in

the case of abandoned farms. Fields become occupied with many weed forms, followed by shrubbery capable of competing with a firm turf of grass, sedge, and other small root forms, after which typical mesophytic forest saplings precede the forest climax. Figure 24 shows a large mountain area of

typical CanadianTransition growth
that has had its
spruce lumbered and
is recovering its
former climax. Paper
birch gained temporary predominance because it grows faster



Figure 24

increasingly over the state, ofte by private citizency. Wise inmbering operations can be carried on to the and they produce almost the same conditions as referential and in some way conditions superior to referestation.

effects of man natural recourse
tends to vegetational "correction!

Figure 25 s s s Telds become completed with the case of abandoned farms. Fields become completed with many wood forms, followed by shrubbery capable of competing with a firm turf of greas, sedge, and other small root forms. Siter which typical mescophybic forest applicat proceeds the forest climax. Figure 24 shows a large nountain area of typical Cunsdian at a second the francition growth that has had its spruce lumbered and the former climax. Paper

than spruce, and seedlings were likely left growing when the spruce was removed. The red spruce is gaining a good foothold in the underbrush, often dominates and will become finally dominant.

7. Finally, that the vegetational development of any area is not a blind chance development resulting from limitation of natural supply of species and forms, but it is the natural, balanced progression of growth regulated by persistent factors or forces effectively modifying any circumstance to the point where it permits the greatest possible development or climax of that area. Finally, the greatest factor in the developing of any vegetational climax is vegetation, itself, at work.

V. S. R. A. 10, 1848

then apruce was removed. The red apruce is gaining a good footield in the anderdrush, often deminates and will become finally deminant.

n. Finally, test the vegetational development of any area is not a blind chance development resulting from limitation of natural supply of species and forms, but it is the natural, balanced progression of fromth regulated by persistent factors or forces effectively modifying any circumstance to the point where it persits the greatest possible development or climax of that area. Finally, the greatest factor in the developing of any vegetational olimax is

#### ORDER OF LITERATURE CITED

- (1) Newberry, J. S. "The Geological History of North American Flora." Tor. Bot. Cl. Bull., Vol. VII, July, 1880.
- (2) Bray, W. L. "Vegetational Development of the State of State of New York." Tech. Bull. No. 29, April, 1930. New York State College of Forestry, Syracuse University.
- (3) Britton, Nathaniel Lord. "The Northern Extension of the New Jersey Pine Barren Flora on Long and Staten Islands." Tor. Bot. Cl. Bull., Vol. 7, July, 1880.
- (4) Bray, W. L. "Vegetational Development of the State of New York." Referring to Paul Graebner's "Allegmeine Pflanzen Geographic."
- (5) Graham, H. W. and L. H. Henry. "Plant Succession at the Border of a Kettle-hole Lake." Tor. Bot. Cl. Bull. Vol. 60, No. 4. April, 1933.
- (6) Bray, W. L. "Vegetational Development of the State of New York," referring to T. C. Hopkins' "Geology of the Syracuse Quadrangle."
- (7) Wilson, W. M. "Frosts in New York." Cornell University Agr. Exp. Sta. Bull. 316, 1912.
- (8) Merriam, C. H., Vernon Bailey, E. W. Nelson, and E. A. Preble. "Fourth Provisional Map of the Biological Survey." U. S. D. A. 1910.
- (9) Merriam, C. H., "United States Biological Survey."
  U. S. D. A. 10, 1898.
- (10) Torrey, John. "Flora of New York" in two vols. Carroll & Cook: Albany, 1843.
- (11) House, Homer D. "Annotated List of the Ferns and Flowering Plants of New York State." New York State Museum Bull. 254., Sept. 1924.
- (12) Harshberger, J. W. "The Plant Formations of the Adirondack Mountains." Torreya, November, 1905.

### CRISI OF LITERATURE CITED

- (1) Newberry, J. S. "The Geological History of North American Flore." Ter. Bot. Cl. Bull., Vol. VII, July, 1880.
- (2) Bray, W. L. "Vegetational Development of the State of State of Mew York." Tech. Bull. No. 29, April. 1930. New York State College of Forestry, Syracuse University.
- (5) Britton, Nathaniel, Lord. "The Morthern Extension of the New Jersey Pine Barren Flora on Long and Staten Islands." Tor. Bot. Cl. Bull., Vol. 7, July, 1880.
  - (4) Sray, W. L. "Vegetational Development of the State of the Paul Graenner's "Asianzan Graenner's "Allegation Pilanzan Geographic."
- (6) Grabar, H. W. and L. H. Henry. "Flant Succession of the Sull. Border of a Mattle-Hole Lake." for. Bot. Cl. Bull. Vol. 59, No. 4. April, 1925.
  - (a) Bray, W. L. "Vegatetional Davalonment of the State of New York," referring to T. C. Hopkins' "Reblogy of the Syracuse quadrangle."
- (7) Wilson, W. M. "Frosts'in New York." Cornell University
  - (8) Morrism, C. H., Vernon Balley, E. W. selson, and E. A. iroble. "Fourth Provisional Map of the Stological Survey." U. S. D. A. 1910.
    - ", vevist lesigolois setate bathu" .. H .O .matrical (9)
- (10) Torrey, John. "Flore of Now York" in two vols. Carroll
  - (11) House, Homer D. "Annotated list of the Peras and Flowering Plants of New York State." New York State Museum Sull. 254. Sopt. 1984.
  - (12) Harshberger, J. V. "The Flant Formations of the Adirondson Lountains." Torreys, November, 1905.

- (13) Peck, C. H. "The Black Spruce (abies nigra)."
  Albany Inst. Trans. Vol. 8, 1976.
- (14) Bien, J. A. "Atlas of the State of New York."
  New York, 1895.

Danksowaki, A. Tomicslesh Sales of This a desactore of

- (13) Pack, C. H. "The Black Spruce (dbiss nigra)."
  Albany Inst. Trans. Vol. 8, 1874.
- (14) Blen, J. A. "Atlas of the State of New York." New York, 1895.

#### BIBLIOGRAPHY

- Bailey, W. W. "Notes on the Flora of the Hudson Highlands." Tor. Cl. Bull. Vol. 13, April, 1886.
- Bien, J. R. "Atlas of the State of New York." New York 1895.
- Bray, W. L. "The Development of the Vegetation of New York State." N. Y. State Coll. of Forestry, Syracuse, N. Y. Tech. Bull. #3, 1915.
- Bray, W. L., "Vegetational Development of the State of New York." N. Y. State Coll. of Forestry, Syracuse, N. Y. Tech. Bull. #29, 1930.
- Britton, Nathaniel Lord. "The Northern Extension of the New Jersey Pine Barren Flora on Long and Staten Islands." Tor. Ch. Bull. Vol. 7, July, 1880.
- Dacknowski, A. "Geological Survey of Ohio Occurrence of Peat." Bulletin 16, Columbus, Ohio, 1912.
- Fox, W. F. "A History of the Lumber Industry in New York."
  U. S. Dept. Agr., Bureau of Forestry, Bull. 34, 1902.
- Gilbert, B. D. "The Fern Flora of New York." Fern Bull. 11, 1903.
- Graham, H. W. and Henry, L. K. "Plant Succession at the Borders of a Kettle-hole Lake." Tor. Cl. Bull. Vol. 60, #4. April, 1933.
- Harper, R. M. "A Long Island Cedar Swamp." Torreya, Vol. 7, 1907.
- Harshberger, J. W. "The Plant Formations of the Adirondack Mountains." Torreya, November, 1905.
- House, Homer D. "Annotated List of the Ferns and Flowering Plants of New York State." N. Y. State Museum Bull. 254, Sept., 1934.
- Howe, M. A. "A Note of the 'Flowering' of the Lakes in the Adirondacks." Torreya, Vol. 3, 1903.
- Jelliffee, S. E. "The Flora of Long Island." Tor. Cl. Bull. 15, 1889.

#### SIBLI OGRAFHY

- Balley. W. W. "Motes on the Flore of the Hudson Highlands." Tor. Cl. Bull. Vol. 13, April, 1886.
- Bien, J. R. "Atlas of the State of New York." New York 1895.
- Bray, W. L. "The Development of the Vegetation of New York State." N. Y. State Coll. of Forestry, Syracuse, N. Y. Tech. Bull. %5, 1915.
  - Bray, W. L., "Vegetational Development of the State of New York." W. Y. State Coll. of Forestry, Syraquae, M. Y. Tech. Ball. #28, 1920.
  - Jorden, Mathaniel Lord. "The Morthers Extension of the Mew Jord Torsey Pine Barren Plora on Long and Staten Talands."
    Tor. Cl. Bull. Vol. 7, July, 1880.
    - Dackmowski, A. "Geological Survey of Chic Cocurrence of Feat." Bulletin 16, Columbus, Chic, 1913.
  - Fox, W. F. "A History of the Lumber Industry in New York."
    U. S. Dept. Agr., Sureau of Forestry, hell. 34, 1803.
- Gilbert, B. D. "The Fern Flore of New York." Form Sall. 11,
- Granam, H. W. and Henry, L. K. "Plant Succession at the Borders of a Mettle-hole Lake." Tor. Cl. Bull. Vol. 50,
  - Harper, R. M. "A Long Island Ceder Swamp." Torreys, Vol. 7,
    - Harshberger, J. W. "The Flant Formstions of the Adlrondsck Homestes." Torreys, Hoverber, 1905.
    - House, Homer D. "Annotated Mast of the Person and Flowering Plants of New York State." N. Y. Stare Museum Bull. 254, Sept., 1954.
    - Howe, M. A. "A Note of the 'Flowering' of the Laves in the Adirondecks." Torreys, Vol. 3, 1903.
  - Jeliffes, S. E. "The Flore of Long Island." Tor. Cl. Bull.

- Merriam, C. H. "United States Biological Survey." U. S. Dept. Agr. 10, 1898.
- Merriam, C. H., Vernon Bailey, E. W. Nelson, and E. A. Preble. "Fourth Provisional Map of the Biological Survey." 1910.
- Newberry, J. S. "The Geological History of North American Flora." Tor. Bot. Cl. Bull. Vol. 8, July, 1880.
- Peck, C. H. "The Black Spruce (abies nigra)" Albany Inst. Trans. 1876.
- Peck, C. H. "Plants of the Summit of Mount Marcy." N. Y. State Mus. Bull. 5, 1899.
- Peck, C. H. "Native Trees of New York." Annual Report of the Forest Com. of N. Y. (for 1891) 1892.
- Prentiss, A. N. "Notes on the Adirondacks." Tor. Cl. Bull. Vol. 10, 1870.
- Stevens, G. T. "The Flora of the Adirondacks." Albany Inst. Trans. Vol. 6, 1870.
- Stewart, P. A. and W. D. Merrell. "The Bergen Swamp--an Ecological Study." Rochester Academy of Science. Vol. 7, #8, August, 1937.
- Torrey, John. "Flora of New York" in two vols. Carroll and Cook, Albany, 1843.
- Wibbe, J. H. "Notes from Central New York." Tor. Cl. Bull. 10, April, 1883.
- Wiegand, K. M. and A. J. Eames. "Flora of the Cayuga Lake Basin, New York." Cornell University Agr. Exp. Sta. Mem. 92, Ithaca, 1926.
- Wilson, W. M. "Forst in New York." Cornel University Agr. Exp. Sta. Bull. 316, 1912.

For further reference to works on the botany of New York State not dealt with in this work, see New York State Museum Bulletin #118, August, 1916. See also: Torrey Botanical Club Publications, New York State College of Forestry Publications, Cornell University Exp. Sta. Publications, Torreya.

- Morrison, C. H. "United States Stological Survey." U. S. Bopt. Acr. 10, 1898.
- Merriam, C. H., Vernon Balley, E. W. Melson, and E. A. Preble.
  - Newberry, J. S. "The Geological History of Worth American
  - Pock, C. H. "The Black Spruce (ables nigra)" Albany Inst. Trans. 1876.
  - Peak, C. H. "Plants of the Sussit of Mount Marcy." M. Y. Stabe Mus. Bull. 5, 1890.
  - Pack, C. E. "Native Trees of New York." Annual Report of the Forest Com. of N. Y. (for 1891) 1892.
  - Prentiss, A. N. "Notes on the Adirondecks." Tor. Cl. Eull.
- Stevens, G. T. "The Flore of the Adfrendacks," Albery last. Trans. Vol. 5, 1870.
- Stewart, P. A. and W. D. Morrell. "The Borgen Smamp--an Ecclogical Study." Acchester Academy of Science. Vol. 7, #3, Angust, 1937.
  - Torrey, John. "Flore of New York" in two vols. Carroll and Cook, Alcany, 1865.
  - Wibbo, J. H. "Motes from Central New York." Tor. Cl. Bull.
    - Wiegand, E. M. and A. J. Esmon. "Flore of the Cayuga lake Beals, New York." Cornell University Agr. Exp. Sta. Mom. 92, 15haca, 1988.
    - Wilson, W. M. "Forst in Mew York." Gornel University Agr. Exp. Sta. Bull. 516, 1912.

For further reference to warks on the belong of New York State Nork State not dealt with in this work, use New York State Manager Mana



